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Tropical Products Institute

G89

Composite flour technology bibliography

Second edition

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D. A. V. Dendy, R. Kasasian, A. Bent,
P. A. Clarke and A. W. James

February 1975

Tropical Products Institute 56/62 Gray's Inn Road London WC1X 8LU

Ministry of Overseas Development

This report was produced by the Tropical Products Institute, a British Government organisation which helps developing countries to derive greater benefit from their renewable resources.

It specialises in post-harvest problems and will be pleased to answer requests for information and advice.

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Preface to the second edition

The first edition, published as TPI Report G71 in 1971, proved very popular. This second edition contains over twice as many references; each is now annotated, and a comprehensive classification has been provided together with Subject and Authors' indexes. This second edition will have appendices published occasionally but it is not proposed to issue another full edition for some time.

Interest in composite flour continues unabated and there are now many groups both in less developed countries and at universities and institutes elsewhere working on the use of non-wheat flour for manufacture of bread and other baked goods. It is an unfortunate fact that, while the stream of publications continues, implementation of composite flour schemes in the less developed countries remains minimal. Furthermore, very little has yet been published on the economic justification for composite flour technology. It is to be hoped that the appendices to this edition will contain references to these very important facets of the subject. A comprehensive study of the economics of composite flour is being prepared by TPI for FAO and will be published shortly.

This bibliography arises from the collective efforts of TPI staff: however a special acknowledgement is due to Mrs. Ruth Kasasian, who has carried out most of the annotating as well as compilation and indexing.

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Preface to the first edition

The habit of eating bread and similar foods made from wheat has spread throughout most of the world. Unfortunately wheat cannot be grown in the humid tropics so that supplies must be imported and be paid for with often scarce foreign currency. It would therefore be to the advantage of wheat-importing countries if these imports could be lessened or eliminated, without reducing the consumption of the retail product. It has been found that the use of non-wheat materials as partial, or total, substitutes for wheat is possible: indeed since ancient times whenever wheat was scarce, non-wheat flours from say, barley and potatoes have been incorporated into bread. These mixtures are now called 'composite' flours, whether or not they contain wheat.

The study of composite flours is fairly recent and has been carried out with the main object of helping the developing countries. The use of protein concentrates to enrich bread is also a recent field of study, but though the developing countries could well benefit from this work, its motivation has usually been the relief of malnutrition among the poor of the metropolitan countries.

The research programme on composite flours at the Tropical Products Institute was begun at the request of the FAO some three years ago, in conjunction with many overseas organisations.

This Bibliography has been compiled as a result of the study of composite flours at TPI and covers the use of non-wheat flours, mostly of tropical origin, as total or partial substitutes for wheat in bread and baked goods manufacture; as well as starch sources (cereals, root crops, etc.) protein sources are also covered. The related fields of pasta and artificial rice are surveyed though not perhaps so comprehensively.

There is a classification under which the references are listed as an aid to easier research. We hope that this Bibliography will prove useful, especially to the peoples of the developing countries.

This is a first edition which we hope to bring up-to-date from time to time, and we therefore trust that any omission will be brought to our attention.

D. A. V. Dendy

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ANON. A1
1970
Investigation on composite flour for bread and biscuit making
Revista del Instituto de Investigaciónes Tecnológicas, Bogotá, Colombia, **12** (66), 5–6. (In Spanish)

ASSELBERGS, E. A. A2
1971
L'interêt de la FAO pour les farines composées
Service des industries agricoles et alimentaires, Division des services agricoles. *Symposium on composite flours, Vienna,* 1971 (Study Group 32: ICC) (In French)

Summary of the work of FAO in encouraging research into, and use of, composite flours in various parts of the world.

ASSELBERGS, E. A. & CHATELANAT,R. P. A3
1972
The introduction of composite flour products in Latin America, Africa and Asia
Cereal Sci. Today **17** (9) (57th Annual Meeting, American Association of Cereal Chemists) Abstract only.

Flour from a wide range of plant material could be included in the term 'composite flour', and in preparing the majority of the products made from it, new additives and new techniques of processing and mixing have to be employed. Rye flour is consumed by millions in Europe and the USSR as a basic dietary item, and many other countries could make more use of local cereals and other suitable food material. Some of the research sponsored by FAO is now being applied in Latin America, Africa and Asia. (Shortened abstract).

BASSE M-T. A4
1971
Importance of cereal research in relation to economic and social development in Senegal
Symposium on composite flours, Vienna, 1971 (Study Group 32: ICC) (In French)

Cereal research in Senegal derives its importance from the insufficiency of cereals to cover the needs of the population. Research is also needed in the case of cassava, sweet potato, cowpeas and groundnuts. There is a résumé of the research required for each crop, and the paper concludes with a survey of the economic and social aspects of the programme.

A5

CIVETTA, A.
1973
Developing a market for composite flours

Cereal Sci. Today, **18** (9). (58th Ann. Meeting, American Ass. of Cereal Chemists). Abstract only.

Study of the organisation of a marketing programme, and the coordination and collaboration between donor and recipient on the executive, advisory and operational levels. (Shortened abstract).

A6

CLAUS, W.
1973
Role of the AACC Composite flour Scientific and Technical Resource Committee

Cereal Sci. Today, **18** (9). (58th Ann. Meeting, American Ass. of Cereal Chemists). Abstract only.

The history, programme and activities of the AACC Composite flour Scientific and Technical Resource Committee are discussed in detail. The opportunity for cereal chemists to respond to the needs for scientific and technical information, as it relates to the utilisation of cereal technology for improving nutrition in the less developed countries, is discussed. The current programme as well as proposed projects are also described. (Shortened abstract).

EDMONDS, M. J. A7

Recommendations to the Government of Colombia concerning the production, processing and utilisation of composite flour made from locally produced raw materials

Joint report of the UNDP mission of consultants sent to Colombia in 1967.

EDMONDS, M. J. A8
1970
A preliminary economic evaluation of the use of non-wheat flours in breadmaking. In: Proceedings of a symposium on the use of non-wheat flour in bread and baked goods manufacture

Tropical Products Institute Report G62, pp 19–21.

The paper discusses whether worthwhile economies can be made in developing countries by replacing part of the wheat used for bread with cassava starch or sorghum flour, supplemented by protein-rich flour such as soya. The appendix gives a detailed cost-benefit analysis and indicates that the social benefit derived from composite flours exceeds that from imported wheat flour. Problems involved in the use of composite flour are outlined.

FOOD AND AGRICULTURE ORGANISATION A9
1973
Composite flour programme

Documentation package Vol. 1 (revised). Food and Agricultural Industries Service, Agricultural Services Division, Rome, Italy.

Contents listed below

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Bulletins and reports published by FAO

Wheat and wheat flour import statistics	FAO Trade Yearbook 1969	19
Bread from composite flours	AGS Bulletin 4 1969	25
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Pan de harinas compuestas	AGS Boletin 4 1969	37
Study of making French-type bread by mechanical dough development mixing wheat flour with cassava starch and millet flour		43

Report of FAO/UNDP Consultant No. 1, 1969. Institute of Food Technology, Dakar, Senegal.

Documents and reports of meetings held at FAO

Documents prepared for the FAO/Industry Cooperative Programme Meeting, FAO, Rome, 20–21 March 1969

Utilisation of agricultural by-products and surplus crops in composite flours 73

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Fd Technol. **22** (7) 1968

Bakery products with non-wheat flours 117
J. C. Kim and D. de Ruiter
Bakers' Dig. **43** (3) 1969

Mechanically developed doughs from composite flours 125
W. Pringle, A. Williams and J. H. Hulse
Cereal Sci. Today **14** (3) 1969

The use of blends of wheat and non-wheat flours in breadmaking 133
D. A. V. Dendy, P. A. Clarke and A. W. James
Trop. Sci. **12** (2) 1970

Forthcoming publications of the composite flour programme
Documentation Package, Vol. 2 149
Provisional Table of Contents
Documentation Package, Vol. 3 151
Provisional Table of Contents

FOOD AND AGRICULTURE ORGANISATION **A10**
1970
Current field activities in composite flour development
FAO/Industry Cooperative Programme, Food Industries and Marketing Subgroup, AGS:G/70/12. See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised 1973).

A brief account of four UNDP/SF projects in which composite flour work is included, in Brazil, Senegal, Niger and Sudan.

FOOD AND AGRICULTURE ORGANISATION **A11**
1973
Summary record of the *ad hoc* working group on utilisation of agricultural by-products; extract on composite flours
IP/AGS/AN:G/69/14. *Document prepared for the FAO/Industry Cooperative Programme Meeting,* Rome, 1969. *FAO Composite flour programme, Documentation package* Vol. 1 (revised, 1973).

FOOD AND AGRICULTURE ORGANISATION **A12**
1973
Utilisation of agricultural by-products and surplus crops in composite flours
IP/AGS/AN:G/69/7. *Document prepared for the FAO/Industry Cooperative Programme Meeting,* Rome, 1969. *FAO Composite flour programme, Documentation package* Vol. 1 (revised 1973).

INGRAM, J. S. **A13**
1971
Selected bibliography on cassava (*Manihot esculenta* Crantz)
Tropical Products Institute Report G51, 35 pp.

LEHMANN, G. & MÜNZBERG, F. **A14**
1972
Food and nutrition problems in developing countries
II Flour and bread manufacture
Ernährungs-Umschau, **19** (9), 316–320. (In German).

Wheat-based composite flours and technique of preparation are discussed. Baking trials illustrate that: water content restricts the use of banana flour; rice is satisfactory; maize and barley are satisfactory with added emulsifiers; yams are promising but need further investigation; and raw and cooked potato, potato flour and sweet potatoes are a suitable substitute for a proportion of wheat flour. Economic aspects are summarised.

MIESEL, H.
1970 A15
Composite flours

Report of FAO/Industry and Cooperative Programme on Food Industries and Marketing Subgroup, AGS:MISC/70/11. See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised 1973).

Summary of the conclusions reached by the *ad hoc* working group on the utilisation of agricultural by-products and surplus crops in composite flours. Recommendations include intensified field work in assisting governments to translate research and development into commercial practice in local bakeries.

METUCHEN, N. J.
1967 A16
Sorghum: a bioliography of the world literature covering the years 1930 to 1963

George Washington Scarecrow Press, Washington, D.C., USA, (*Biological sciences communication project*) 301 pp.

METUCHEN, N. J.
1967 A17
The millets: a bioliography of the world literature covering the years 1930 to 1963

George Washington Scarecrow Press, Washington, D.C., USA, (*Biological sciences communication project*) 154 pp.

ROLFE, E. J.
1971 A18
Training overseas students in composite flour technology

Proceedings of a symposium on the use of non-wheat flour in bread and baked goods manufacture, Tropical Products Institute Report G62, 33 pp.

M.Sc. options in food technology attract a number of students from developing lands. Students have carried out experiments in the use of various rice flours in bread (0 – 50%), and cassava flour in biscuits (0 – 25%). The rice flours showed little analytical variation but considerable differences in reaction on the loaf. Little difficulty was found in incorporating 15% cassava flour in the biscuits, but 25% additions required modifications in dough handling.

SPENSLEY, P. C., HALLIDAY, D. & ORR, E.
1972 A19
The prospects for 'non-conventional' protein resources

Trop. Sci. **14** (3), 203–233.

Paper commissioned by the UN for use in connection with its preparation of a strategy statement on the protein problem confronting the developing countries. It contains information on the utilisation of oilseeds, cereals, fish protein concentrate, leaf protein and protein concentrates in flour, bread and other food products.

1972 A20
Symposium on the production and marketing of composite flour baking products and macaroni goods, Bogotá, Colombia

Papers listed below.

Asselbergs, E. A. — The FAO composite flour programme, a survey of activities in Latin America, Africa and Asia. (Food and Agricultural Industries Service of the Agricultural Services Division, FAO, Rome).

Bacigalupo, A. *et al*	Technological and nutritional research on the use of potato in bread production. (Universidad Nacional Agraria, Lima, Peru).
De Benítez, P.	Situación del Ecuador respecto a la producción, importación y consumo de trigo. Disponibilidad de materias primas para le sustitución del trigo-ensayos farinologicos y de panificación, usando como sustitutos del trigo, harina y almidon de yuca y harina de papa (Instituto de Investigaciónes Tecnológicas de la Escuela Politécnica Nacional, Quito, Ecuador).
Bushuk, W.	Composite flour research in Canada. (Canadian International Grains Institute, Winnipeg, Canada).
Civetta, A.	Studies on the manufacture of alimentary pastas with composite flours by the Instituto de Investigaciónes Tecnológicas. (Bogotá, Colombia).
Clarke, R. & Pollard, M.	Composite flour experimentation in Guyana.
Cohenea, J. M.	Production, importation and consumption of wheat in Paraguay. Native flours used as substitutes for wheat flour: production and prices. Tentative projects about composite flours.
Contesse, G.	Identification, formulation, submission and implementation of UNDP-funded projects. (FAO Regional Office, Santiago da Chile).
Dendy, D. A. V.	The Ceylon (Sri Lanka) composite flour project set up by the Ceylon Institute for Scientific & Industrial Research & The Tropical Products Institute. (Food Processing Section, Tropical Products Institute, Culham, Oxon, UK).
Dialle, R.	Statement. (Niger).
Dumont, J. J.	Aspectos del problema del trigo a nivel del continente Suramérica. (FAO, Bogotá, Colombia).
Estrada, A. del V.	Agricultural, economical and political factors affecting the supply of raw materials in Colombia. (Instituto de Mercadeo Agropecuario).
Ferrari, C. R. V.	Wheat and flour data: present research on composite flours in Chile. (Universidad de Concepción, Chile).
Groenendijk, P. R.	The market research programme for composite flour bread in Colombia (1). (FAO, Bogotá, Colombia).
Hoover, W. J.	Improvement of nutritional value of cereal foods in Morocco and Pakistan. (Kansas State University).
Kim, J. C.	Manufacturing biscuits from composite flours. (TNO, Wageningen, Netherlands).
Leitao, R. F. *et al*	Manufacturing macaroni products from composite flours. (Instituto de Tecnológia de Alimentos Campinas, São Paulo, Brazil).
Milner, M.	PAG guidelines and recommendations; their application to composite flour products. (Protein Advisory Group (PAG) of the UN System, New York, USA).
Monsalve, A.	Algúnas notas sobre el crite que mantiene el ministerio de agricultura y Cria de Venezuela al respecto del tema harinas compuestas. (División de Economia Agricola, Ministerio de Agricultura y Cria, Caracas, Venezuela).

Montealegre, A.	Statement. (Nicaragua).
de Mosqueda, M.	Proyecto para utilizar los excedentes de arroz existentes en Venezuela. (Depto. de Tecnológia de Alimentos, Fac. de Ciencias, UCV).
Mustafa, A. M. I.	Brief statement on the situation of wheat and composite flour in the Sudan. (Food Research Centre, Khartoum North, Sudan).
Parra, C.	The market research programme for composite flour bread in Colombia II. (Instituto de Investigaciónes Tecnológicas, Bogotá, Colombia).
Perten, H.	Composite flours in Senegal.
Sammy, G. M.	The status of composite flour research at the University of the West Indies. (St. Augustine, Trinidad, West Indies).
Sanchez, F.	Desarollo de alimentos formulados en Chile.
Sluimer, P.	The Colombian composite flour project and the preparatory studies made in the Institute for Cereals, Flour and Bread (TNO). (Wageningen, Netherlands).
Tai-Wan Kwon	Importance and present status of composite flour project in Korea. (Korea Institute of Science and Technology, Seoul, Korea).
Ward, A. B.	Principles of milling, with special indication of the modifications required in milling different cereals. (Kansas State University, Department of Grain Science and Industry, Manhattan, Kansas).
Wilkie, N. A.	Market responses to the composite flours concept. (Nutrition Division, FAO, Rome).

T.N.O. (Institute for Cereals, Flour and Bread) **A21**
1973
'Interpan'. Summary of the Joint Report on the Colombian-Netherlands Composite Flour Project, carried out in Bogotá in 1971–1972

Issued jointly by the Institute for Cereals, Flour and Bread (TNO) Wageningen, Netherlands; Instituto de Investigaciónes Tecnológicas, Bogotá; Bureau for International Projects, The Hague, Netherlands; FAO, UN Food Policy and Nutrition Division, Rome, Italy.

The complete report, of which the present paper is a summary, comprises four parts:

Part 1 Recommendations
Project conclusions
Description of the project
Summary of the results
Part 2 Technological part
Part 3 Consumer research and marketing programme
Part 4 Economic aspects

TOSELLO, A. A22
1970
Flours in Brazilian nutrition
Bolm Inst. Technol. Alimentos, **21**, 1–8. (In Portuguese)

Reviews
(1) Food situation in Brazil as regards carbohydrates.
(2) Sources of carbohydrate in Brazil.
(3) Flour production in Brazil. Cassava, maize, wheat, soya.
(4) Wheat flour compared with other flours from an industrial and commercial point of view.
(5) Prospects for a flour programme in the baking industry.

TOWNSEND, F. R. A23
1971
Brief note of the Australian work having a relation to the terms of reference of the ICC Study Group 'Composite Flours'
Symposium on composite flours, Vienna, 1971 (Study Group 32: ICC)

TROPICAL PRODUCTS INSTITUTE A24
1971
Proceedings of a symposium on the use of non-wheat flour in bread and baked goods manufacture
Held at the Tropical Products Institute in November 1970. *Tropical Products Institute Report* G 62, 33 pp.

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Summary of Introduction by Dr E. Asselbergs

Paper 1 The work of the Tropical Products Institute on the use of non-wheat flours in breadmaking, by D. A. V. Dendy, A. W. James and P. A. Clarke. (See B13).
2 Breadmaking with non-wheat flours, by D. de Ruiter. (See B36).
3 Nutritional aspects, by F. Aylward. (See Ja 7).
4 The Cambridge Formula loaf, by A. M. Buchanan. (See Ja 14).
5 Training overseas students in composite flour technology, by E. J. Rolfe. (See A16).
6 A preliminary economic evaluation of the use of non-wheat flours in breadmaking, by M. J. Edmonds. (See A8).

General Discussion

WEISBERG, S. A. A25
1973
Exploiting grass-roots food technology in developing countries
Fd Technol., **27** (5) 70, 72, 80.

Utilisation of locally available food resources in developing countries is discussed. The addition of legumes, oilseed flour or rice polish to wheat flour in breadmaking is one method described. Various methods of utilising banana are mentioned, as are other tropical vegetables and fruits, and soya bean products.

WEISBERG, S. M. A26
1973
Spotlight on baked goods for the developing world
Cereal Sci. Today, **18** (2) 47–50.

The author, of the League for International Food Education, reviews the case for supplementation of imported wheat by local raw materials, discusses the use of improvers, reviews progress made in gaining acceptance for fortified baked goods in many parts of the world and summarises the conditions required for future progress.

WILKIE, N. A. A27
1971
Consideration of the acceptability and marketability of composite flour to the consumer

Symposium on composite flours, Vienna, 1971. (Study Group 32: ICC)

A review of further steps in a global research effort into the use of composite flours, with emphasis on the need for on-the-spot field surveys to ensure that products will be appetising and match the consumer's needs. A pilot project in Colombia is outlined.

See also Ja 26, 27, 31, 44, 49, 56, 61.

Leavened bread

ANON. B1
1918
War breads in various lands: a comparison of the regulations
Milling, **50** (25), 529.

A reader contributes to the journal a comparison of the wartime breads in different countries and cites the percentage incorporation of non-wheat flours. He concludes that the darker, coarser breads have always been associated in the mind of the consumer with war and privation, and that white bread is thus all the more popular when available.

ANON. B2
1969
Brazil: wheat substitutes for bread could save imports
Span, **12** (2), 63–64

News item concerning the work at Campinas on the feasibility of using locally grown crops (maize, soya and cassava) as a partial substitute for wheat in bread-making.

ANON. B3
1971
Gaining acceptance for bread made from composite flours
Milling, July 1971, No. 7, pp 18–20.

A report by the Science Editor: reviews the history of bread-production from composite flours and draws attention to an encouraging report from FAO.

ANON B4
1971
Blended flours for developing lands?
Milling, Vol. CLIII No. 10.

Half-page article on the production at the Tropical Products Institute, Industrial Development Department, Culham, Oxon, UK, of bread from non-wheat/wheat flour blends by the Chorleywood Process.

B5

ANON
1971/72
Field Report No. 4. Taste testing of composite flour bread at two schools. Appendix A: Taste testing at the Institute

Field Report No. 5. To test the acceptability of composite flour bread under controlled conditions.

Instituto de Investigaciónes Tecnológicas, Bogotá, Colombia.

B6

BORASIO, L.
1933
The use of substitutes in breadmaking
G. Risic., **23** (9), 193–212. (In Italian)

A review of work in Italy on the characteristics and suitability of various wheat substitutes for use in bread making. The most important minor cereals (rye, oats, rice, barley, maize), also potato and legumes are dealt with and the author makes recommendations as to milling, processing and levels of substitution.

B7

BRÜMMER, J.-M.
1972
The specific volume of bread as a quality criterion. II Rye and mixed rye bread
Getreide, Mehl und Brot, **26** (9), 234–237. (In German).

Previous work, using mainly wheat flour, was continued using rye flour and rye/wheat mixes. Data are presented in tables and diagrams, showing loaf volume and specific volume, and the relation between these and loaf weight in the range 750–1500 g. Specific volume tended to increase with increasing loaf weight and was significantly lower for rye than for rye/wheat bread. The suggested specific volume for practical assessment of loaf quality is given.

B8

BRÜMMER, J-M.
1972
The specific volume of bread as a quality criterion. III Effect of rye and wheat flour quality and amount of added water on the specific volume of rye/wheat bread

Getreide, Mehl und Brot, **36** (10), 269–271. (In German).

The usual analytical data are provided for the wheat and rye flours used. Three rye flours of low, normal and high enzyme activity were selected, and four wheat flours classified as average-protein-enzyme-rich; average-protein-enzyme-poor; high-protein-enzyme-rich; and high-protein-enzyme-poor. Mixed flours with a rye: wheat ratio of 70:30, were used for bread baking. Specific volume results are tabulated for combinations of the various wheat and rye flours, with the level of water addition to the dough also taken into account. The importance of enzyme activity is stressed; if this is high an average protein content will produce good specific volume.

B9

LE CLERC, J. A. & WESSLING, H. L.
1918
The chemical analysis of wheat flour substitutes and the breads made therefrom
USDA Bulletin No. 701.

The bulletin gives the tabulated analytical results of more than 30 wheat flour substitutes and of the bread made from blends of these with wheat flour (25:75). The substitutes used include starches (from fruits, tubers, roots and nuts), cereals, legumes and by-products such as cotton seed and wheat germ.

DENDY, D. A. V. & CLARKE, P. A. B10
1969
Interim report on the use of non-wheat flours in breadmaking

Tropical Products Institute Report G50, 26 pp.

Experiments in the test bakery at the Industrial Development Department of TPI have led to the development of bread of good quality, made by mechanical dough development from a blend of 50% wheat flour and 50% cassava starch. This bread can be satisfactorily fortified with protein concentrates derived from, for example, coconut or soya, and it has also been made successfully in a commercial bakery. In this report, full details are given of the work carried out during the evolution of suitable formulae and methods, and a brief note on future work is appended.

DENDY, D. A. V. B11
1970
Work on composite flours conducted in the test bakery of the Tropical Products Institute, Culham, UK

Report of FAO/Industry Cooperative Programme, Food Industries and Marketing Subgroup, AGS/MISC/70/20. See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised 1973).

Initial work with cassava/wheat blends confirmed that the Chorleywood Process was superior to bulk fermentation. Soya and coconut protein were tried for protein replacement. Tropical cereals such as sorghum, millet and rice were also tested, with some success. Up to 20% yam flour gave reasonable results. Less successful results were obtained with FPC, cotton seed flour, groundnut flour and leaf protein concentrate. The limit of tolerance of wheat flour to extension with other material will depend on the quality of the flour itself, the type of diluents used and the breadmaking method.

DENDY, D. A. V., CLARKE, P. A. & JAMES, A. W. B12
1970
The use of blends of wheat and non-wheat flours in breadmaking

Trop. Sci. **12** (2), 131–142. See also *FAO Composite flour programme, Documentation package.* Vol. 1 (revised 1973).

Work on composite flours in breadmaking at the Tropical Products Institute is described. Initially efforts were directed at producing bread from 50:50 blends of wheat and cassava flours. The Chorleywood Breadmaking Process enabled incorporation of 60% cassava flour, as compared to 50% with the bulk fermentation process. 50% rice flour was unsatisfactory, but 40% rice with 60% wheat gave reasonable results. 10% rice and 40% cassava flour gave a good bread. Most tropical starches contain little protein, and bread made from them requires enrichment with soya flour, coconut protein or milk solids.

DENDY, D. A. V., JAMES, A. W. & CLARKE, P. A. B13
1971
Work of the Tropical Products Institute on the use of non-wheat flours in breadmaking

Proceedings of a symposium on the use of non-wheat flour in bread and baked goods manufacture, Tropical Products Institute Report G62.

Different wheat flours were diluted with various proportions of cassava starch, and the blends processed by three different breadmaking systems. Mechanical dough development gave the best bread and allowed incorporation of 10% more non-wheat material than other methods. More nutritious blends were also tested; soya, cotton seed, groundnut, leaf protein, FPC and coconut protein isolate with wheat flour. Tropical cereals such as sorghum, millet, rice and maize were also tried in wheat blends. It was found that 20% yam flour could be used without serious adverse effects.

FOOD AND AGRICULTURE ORGANISATION B14
1969
Bread from composite flours

FAO Agricultural Services Bulletin No. 4, 6 pp. See also *FAO Composite Flour Programme, Documentation package.* Vol. 1 (revised 1973).

Review of past and present work in the development of new techniques for producing bread entirely from non-wheat flours and from extended wheat flour. Typical recipes are given for gluten-free bread, and for bread using wheat-based composite flours. There is a section on mechanically developed doughs, with a formula for composite flour bread produced by the Chorleywood Process. A table illustrates the percentages of non-wheat flours successfully incorporated by means of this technique.

FOOD AND AGRICULTURE ORGANISATION B15
1971
Blended bread helps developing countries make foreign exchange savings

FAO News Feature NF/71/4, Nu/3, 2 pp.

Senegal hopes to save $600,000 (10% of normal expenditure) in the first year of using 30% of local millet flour in place of imported wheat. Research in the Netherlands, financed by the Freedom from Hunger Campaign, led to the development of white crumb bread based on manioc flour, with no wheat flour, but with additional vegetable protein in the form of groundnut or soya. In Senegal an acceptable French-style "baguette" loaf was developed from blended wheat and millet flours.

FOOD AND AGRICULTURE ORGANISATION B16
1973
Note on mechanically developed doughs from composite flours

Document prepared for the *FAO/Industry Cooperative Programme Meeting, Rome* 1969. IP/AGS:G/68/20. *FAO Composite flour programme, Documentation package.* Vol. 1 (revised 1973).

HANH, P. & RASPER, V. B17
1973
The effect of non-wheat pentosans on the physical properties of doughs from composite flours

Cereal Sci. Today, **18** (9). (58th Ann. Meeting, American Ass. Cereal Chemists). Abstract only.

Water soluble and insoluble pentosans extracted from flours prepared from two species of yam and from sorghum (all from W. Africa) were compared with pentosans of a typical Canadian wheat flour. The effect of these pentosans on the rheological behaviour of the unfermented dough was studied, and the results were correlated with baking tests. Other tests showed some slight strengthening of the elastic response of the dough when water soluble pentosans from wheat and yam were added, and the extensibilities of the doughs were reduced by both soluble and insoluble pentosans regardless of their origin. (Shortened abstract).

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE B18
1973
The staff of life: new ways to make bread

International Development Research Centre (Canada) Reports, 2(2)
(In English and French)

A current IDRC project involves baking with composite flours in which wheat is extended with varying proportions of maize, sorghum, millet, African faba beans and chickpeas from Asia. Methods of production using hand- or foot-powered machinery are being adapted. Non-wheat cereals have been found satisfactory at levels of incorporation of up to 20%, and the legume additions are expected to bring the protein content of loaves up to 20% or more.

JONGH, G., SLIM, T. & GREVE, H. B19
1968
Bread without gluten

Bakers' Dig. **42**(3), 24–29. See also *Brot Gebäck* 1967, **21**(9), 165–173

The authors give the results of breadmaking trials using starch/water doughs with the addition of gliadin and gluten, egg albumin, triglycerides, glyceryl monostearate and polyoxyethylene stearate. The role of starch in the production and staling of bread is discussed, and in other trials wheat starch was replaced by cassava starch, in some instances with the addition of soya flour and groundnut flour.

JONGH, G. B20
1970
The development of composite flours

FAO/Industry Cooperative Programme on Food Industries and Marketing Subgroup, AGS/MISC/70/21. See also *FAO Composite flour programme, Documentation package,* Vol. 1 (revised 1973)

In 1965 tests were begun to determine whether bread could be made entirely from non-wheat indigenous products. The best results were obtained with 80% cassava starch and 20% defatted soya flour. A number of other raw materials were tried, both in combination with each other and with wheat flour. 70 parts wheat flour, 25 parts cassava starch and 5 parts defatted soya flour with emulsifier proved a successful blend.

KENDE, Z. & KETTING, F. B21
1968
Verfahren zur Herstellung von eiweissreichen Broten, Back- und Teigwaren

West German Patent No. 1 442 021.

KIM, J. C. & DE RUITER, D. B22
1968
Bread from non-wheat flours

Fd. Technol. **22**(7), 867–878. See also *FAO Composite flour programme, Documentation package,* Vol. 1 (revised 1973)

The authors describe pilot scale work (with tables and illustrations) to produce palatable bread from 70% yam flour/30% low-fat groundnut flour; 70% yam flour/ other protein components; 70% cassava, sago or matanta flour/30% groundnut flour; cassava flour/ soya; and cassava starch/soya. The nutritional value, net protein utilisation, digestibility, PER and biological value were determined, and it was concluded that the protein quality of both the cassava/soya and cassava/ groundnut breads was higher than that of wheat bread alone, the cassava/soya being the best of the three.

B23

KIM, J. C. & DE RUITER, D.
1969
Bakery products with non-wheat flours
Bakers' Dig. **43**(3), 58–63. See also *FAO Composite flour programme Documentation package* Vol. 1 (revised, 1973). See also *Reunión Latino-Americana de especialistas en la elaboración de harinas y panificación.* Instituto de Tecnologia Agricola y de Alimentación, Ministerio de Agricultura, Brazil, 10–14 March 1969, pp 13–25

A study of formulae and procedures using mixtures of cassava and soya flours; cassava and groundnut flours; maize and soya flours; maize, cassava and soya flours and also of non-wheat flour and wheat flour.

B24

KIM, J. C.
1971
Bakery products from flour from tropical plants
Voedingsmiddeletechnologie, **2**(52), 1–5. (In Dutch)

In the baking of bread from a blend of 80% cassava and 20% defatted soya bean flour, the addition of glyceryl monostearate (GMS) was required to improve crumb structure. Flours from maize, millet, sorghum and rice were submitted to baking trials, which proved unsatisfactory. The addition of calcium or sodium stearoyl lactylate or of acetylated tartaric esters of mono- and di-glycerides resulted in satisfactory bread from a mix of wheat flour and 30% non-wheat flours prepared from cassava, millet and maize, with soya or caseinate. Biscuits were made from 2 parts cassava flour or cassava starch meal and 1 part defatted soya bean or groundnut flour.

B25

LAND, T. (Journalist)
1972
New bread process will ease world's food problems
South China Morning Post, Hong Kong.

News item concerning a new experimental bakery in Nigeria, producing bread from cassava, sorghum, etc. Related developments by TNO in the Netherlands, under the auspices of FAO, are reported.

B26

LEHMANN, G.
1971
Food and nutrition problems in developing countries. I. The bread situation
Ernährungs-Umschau, **18**(12), 505–510. (In German)

A review of the cultivation, yield, nutritional value and utilisation of yams, tapioca, potato, sweet potato, maize, rice and bananas, with reference to economic factors and to the production of bread from plant sources other than wheat. Tables show the calorific value, and carbohydrate, fat, protein and water contents of the above crops. Typical analyses of wheat and *Chenopodium quinoa* are also given. The effect of glyceryl monostearate in bread from indigenous plants and from blends of these with wheat flours should be studied.

B27

LÜDDEKE, J., SEIDEMANN, J. & REICHELT, P.
1971
Method of increasing the yield of dough and bread
East German Patent No. 80,872

A method is described of increasing dough yield for wheat, rye, and mixed wheat and rye breads by using mechanical aeration or chemical aerating agents and by increasing the amount of water in the recipe.

VAN DER MADE, C. B28
1970
Bread from composite flours: progress report with reference to Brazil

Report of FAO/Industry Cooperative Programme. Food Industries and Marketing Subgroup, AGS:MISC/70/11. See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised 1973)

In 1968 wheat consumption in Brazil was 39 kg per capita. The government is expected to restrict wheat imports; already a compulsory 5% cassava flour is incorporated in wheat products. Tests at the Institute of Food Technology in Rio de Janeiro showed that 10% of cassava flour plus 5% of cassava or maize starch can be added to medium strength wheat flour, shortening being replaced by 0.3–0.5% sodium stearoyl lactylate. Weight yields can be safeguarded by adding extra water. Where necessary, extra protein can be incorporated in the form of 3% of calcium proteinate (soya bean).

DE MARTIIS, P. B29
1969
The effect of additions of cassava starch, cornflour and pre-cooked cornflour on the breadmaking quality of commercial wheat flours

Revista del Instituto de Investigaciónes Tecnológicas, Bogotá, Colombia, **11**(58), 9–18. (In Spanish)

NICHOLSON, J. B30
1970
Changing the Indian bread-consumption pattern

Cereal Sci. Today, **15**(9)

A review of the background to the introduction in India of 'Modern Bread' under the Colombo Plan. A survey of the bakery industry and of the rural and city markets for bread is included.

PARRA, C. P. C. B31
Harinas compuestas para panificación en Colombia

Instituto de Investigaciónes Tecnológicas, Bogotá. (In Spanish)

PERTEN, M. H. B32
1967
Non-cereal bread from composite flours

FAO/WHO/UNICEF/PAG Meeting Document, 10/117, October 1967, 7 pp

PERTEN, M. H. B33
1969
Report on the manufacture of French-type bread (In Senegal)

FAO/AGS:SF/SEN 5. *Rapport d'expert-conseil* No. 1. (In French). See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised, 1973)

Recommendations to FAO regarding a programme of research to be undertaken at the Institute of Food Technology in Dakar into the production of French-type bread from composite flours consisting of (i) wheat flour, 30% millet flour and 5–10% groundnut flour and (ii) wheat flour with 20–30% cassava starch enriched with soya or groundnut flour.

PERTEN, M. H. B34
1971
Studies on the introduction of millet and sorghum in breadmaking in Senegal
Symposium on Composite Flours, Vienna, 1971 (Study Group 32:ICC) (In French)

The Institute of Food Technology in Dakar has carried out tests on the use of composite flours in breadmaking. The author describes the cultivation and production of cereals in Senegal, and gives methods and recipes used for the experimental breads. The analyses and results are tabulated.

POMERANZ, Y. B35
1971
Glycolipids-protein interaction in breadmaking
Bakers' Digest, **45**(1), 26–31, 58.

The evidence for glycolipid-protein interaction, the chemistry of the components, the mechanism for the interaction and its effects in breadmaking and in protein-rich bread are reviewed.

PRINGLE, W., WILLIAMS, A. & HULSE, J. H. B36
1969
Mechanically developed doughs from composite flours
Cereal Science Today, **14**(3), 114–118. See also *FAO Composite flour programme, Documentation package* Vol. 1 (Revised, 1973)

A study of mechanical dough processing from blends of 'strong' wheat flour with cassava, maize, millet and sorghum fortified with protein concentrate. The mechanical process produced bread superior to that of conventional processes. Energy input and oxidising treatment as recommended for the Chorleywood Bread Process with 20% GMS emulsion gave the best bread.

DE RUITER, D. B37
1971
Breadmaking with non-wheat flours
Symposium on the use of non-wheat flour in bread and baked goods manufacture, Tropical Products Institute Report G 62.

In 1965 an investigation was begun into the production of bread containing non-wheat flour; starch substitutes were cassava, yam, maranta and sago; protein concentrates were soya, groundnut, cotton seed, fish meal, etc.; gluten substitutes were alginates, vegetable gums and pregelatinised starches, with lecithin and glyceryl monostearate as emulsifiers. Best results were obtained with soya or groundnut combined with cassava. Results are given of other trials using composite flours containing 70% wheat flour.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION B38
1971
Bread before cakes is good for national economy
UNIDO Press Release, Feature No. 4, 2 pp

Press release relating experiences of a UN bakery consultant in Chad, who initiated the use of up to 50% locally grown millet and sorghum to replace imported wheat. It was found that machinery designed for wheat milling was equally efficient for sorghum and millet. Loaves containing 40% millet flour were sold at 30% less than all-wheat bread.

See also

A. 1:14:18:19:24–26
D. 14:18
F. 35
Ga. 1
Gb. 1–4:12–14:16:17:19:20
Gc. 1–4:7:9–12:14
Gd. 2:3:5:7:10
Ge. 2
Gg. 1
Gh. 1:3:4
Gj. 1:4
Gk. 2
Hb. 1:2:5:7:8
Hd. 1:2
He. 1:3–7
Ja. 4:5:14:15:18:19:21:22:24:26:30:31:33:36:41–45:47:51–56:58:59:63:68–70
Jb. 1–4:6–9:11:15–17:21:22:24–43:46:47:49–53:55:57
Jd. 2:4–6:9:10–13
Je. 2
Jg. 1:2
Jj. 1:3–5
Jk. 1:2:6–10:12:13
Jm. 1:3:6–8;11–15:17–19:23:25:28
Jn. 2:3:5:8
Jo. 9:12:16:17:21:23:25
Jq. 2

Unleavened bread

BASS, J. L. AND CAUL, J. F. **C1**
1972
Laboratory evaluation of three protein sources for use in chapati flours
J. Fd Sci., **37** (1), 100–102

Nine protein-supplemented flours for chapati preparation were studied. FPC, cottonseed flour and soya protein concentrate were used. Chemical analyses of the test flours and flavour profile comparisons of chapatis are tabulated, and the results discussed.

CHAUDRI, A. B. & MULLER, H. G. **C2**
1970
Chapatis and chapati flour
Milling, **152** (Nov. 1970) 22–25

Diagrams and tables show the tonnage, acreage and distribution of cereal crops in Pakistan. Pakistan wheats are analysed and the chapati-baking characteristics of some Pakistan flours are tabulated. Recipes and methods are given for the baking of chapati, roti and nan (which contains chickpea flour).

HEDGES, N. J. & TINKLIN, G. L. **C3**
1969
Chapati quality as affected by wheat protein concentrate
Cereal Sci. Today, **14** (10), 344–346

Wheat protein concentrate was substituted satisfactorily for part of the whole wheat flour in Indian chapatis. It was found that the use of 0, 10 and possibly 20% WPC to replace equal weights of whole wheat flour in chapatis would make acceptable products. In general, the treatment containing 50% WPC was not as well received by the judges as the other three. Nevertheless, it appeared that good quality chapatis could be made by including some WPC and that it could be recommended for increasing the nutritive value.

KHAN, M. N., ROBINSON, R. J., WANG, M. & HOOVER, W. J. **C4**
1972
Effect of protein-rich flour and sodium stearoyl lactylate on chapati (Indian non-leavened bread)
Cereal Sci. Today, **17** (9), (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only

A major source of protein in India and the Middle East is legume in the form of 'daal'. The present study examined baking quality and palatability of standard chapati made with various proportions of soya, horsebean, chickpea and groundnut flours, with sodium stearoyl lactylate. In softness tests, 5% soya flour + 0.5%

SSL proved to be the most satisfactory blend. The organoleptic tests showed the order of preference to be chickpea, soya, horsebean and groundnut.

(Shortened abstract)

RATHOD, K. L. and WILLIAMS, S. W. **C5**

1970

Consumer acceptance of chapatis containing soyabean flour

Indian J. agric. Econ., **25** (4), 68–72

Up to 20% of good quality soya flour was incorporated in chapatis made from wheat flour without appreciable adverse reaction from consumers.

See also
Gb. 7:8
Hb. 10
He. 7
Ja. 46
Jd. 11
Jj. 1
Jn. 3:5
Jo. 20:21:25

Flour confectionery, biscuits

BAINS, G. S., HARIDAS RAO, P. & NARAYANASWAMY, D. D1
1967
Study of the factors contributing to longer shelf-life and quality of protein-rich biscuits

Ann. Bull. Central Food Technology Research Institute, Mysore, India.

The effect of baking on the stability of anti-oxidants in biscuits based on screw-pressed groundnut flour was evaluated. A commercial sample of protein-rich biscuit developed oxidative rancidity after 4 months of storage at 55°C. Several flavouring agents were also screened for compatibility with protein-rich biscuits based on groundnut flour. The replacement of groundnut flour with cotton seed flour in high protein biscuits was found to be feasible.

BUCHANAN, R. A. & TOWNSEND, R. F. D2
1967
Lactose-free milk solids in biscuit form

Aust. J. Dairy Technol., **22** (3), 139–143

Sucrose and wheat starch were used as sources of carbohydrate in place of lactose in a milk biscuit containing protein, fat and carbohydrate in the same proportions as in whole milk. The nutrients can be supplemented with minerals and vitamins and the keeping quality is comparable to that of commercial shortbread or other sweet biscuits.

BUCHANAN, R. A. & TOWNSEND, R. F. D3
1969
The Australian milk biscuit. Production for use in Africa and Asia

Aust. J. Dairy Technol., **24** (3), 113–115. See also *Dairy Inds*, **34** (11), 729–730

A recipe is given for a lactose-free biscuit containing a milk protein which absorbs little water and can be incorporated at quite high levels. The nutrient contents are tabulated. The biscuits are intended for ethnic groups unaccustomed to drinking milk after weaning, and can be softened for infant feeding.

CONWAY, H. F. & ANDERSON, R. A. D4
1973
Protein-fortified extruded food products

Cereal Sci. Today, **18** (4), 94–97

Mixtures of yellow corn snack grits with four high-protein products, and five other starchy materials with soya flakes, were processed in a high-temperature short-time extruder. These extruded products are completely cooked and have potential as a base for gruel or soups; as a beverage, especially if sweetened and flavoured; and after coating with oil and adding seasoning, as a high-protein snack item.

GABBY, J. L. & ASHBY, G. D5
1968
Method for the production of wafer-like bakery products with high protein content
West German Patent No. 1 442 024

GLABE, E. F. D6
1971
Bread-like products
USA Patent No. 3 615 658

Bakery products are prepared from a dough containing a starch, an oilseed protein and water.

GRALAK, B. G. & HYDON, R. G. D7
1969
Instant cereal products
West German Patent Application 1 917 550. (In German)

Denatured grain (barley, maize, rice or wheat) is mixed with a fruit ingredient, cooked, drum dried to less than 10% moisture and comminuted to form a dry instant cereal product for rehydration prior to use. Dried skim milk or soya protein can be added to give an end protein content of 10–20% by weight.

GUADAGNI, D. G. & VENSTROM, D. D8
1972
Palatability of pancakes and cooked corn meal fortified with legume flours
J. Fd Sci., Vol. 37, pp 774–7

Wheat flour/legume flour (navy bean) pancakes were compared with wheat flour controls, and cornmeal/legume pancakes with cornmeal controls in experiments to assess palatability. Nutrient changes are tabulated and compared. The legume blends were also compared with pancakes from wheat/de-fatted soya flour blends. All legume-containing pancakes received favourable flavour ratings, and, like the soya blends, were often preferred to the controls.

HACKLER, L. R. D9
1972
Nutritional evaluation of protein quality in breakfast foods
Cereal Chem., **49** (6), 677–683.

The protein quality of several breakfast foods based on oats or wheat as a source of protein was evaluated alone and in combination with casein. The need for duplication as far as possible of human consumption patterns and requirements in such studies is emphasised.

MIYAMOTO, T. D10
1965
Improvements in or relating to the manufacture of biscuits
British Patent No. 988, 131

Boiled bean flour is suspended in water and acted on by a mixture of protease and amylase at 30°C for 12 hours to decompose it. Biscuit flour, sugar, shortening and bean flour are mixed to form a dough which is then sandwiched between two layers of ordinary dough before shaping and baking. The biscuits are claimed to be highly digestible, with high nutritive value and pleasant taste.

MUSTAFA, A. I., MAHGOUB, S. I. N. & ABDO, S. **D11**
1971
Ginger biscuits from dura (*Sorghum vulgare*)
Sudan J. Food Sci. and Technol., **3**, 30–33

Five varieties of sorghum and one of millet were used in the experimental manufacture of ginger biscuits. After modifications, a recipe was formulated and an acceptable product was obtained from all the varieties of sorghum. The trial recipe is given. Millet was found to produce an inferior biscuit. The protein content was low (7–9%) and a protein supplement is considered.

PRABHAVATHI, C., USHA, M. S. & BAINS, G. S. **D12**
1973
Effect of baking on the protein quality of high protein biscuits
Ind. J. Nutr. Dietet., **10** (91)

Experiments were made to assess the effect of baking on high-protein biscuits prepared in the laboratory (wheat, soya bean, wheat germ and pea) and by commercial firms. Baking caused significant PER loss in two biscuit samples, and in the third, where the flour was better balanced and optimally baked without reducing sugars, the loss in PER was only 13%. The PER of a commercial brand of biscuit was low (0.98), probably due to excessive browning.

RISPOLI J. M. & CAPOSSELA, A. C. **D13**
1972
Snack food product
Canadian Patent No. 907 938

Comminuted popped popcorn is combined in a dough with tapioca flour, cornflour and potato starch, and deep fried.

DE RUITER, D. **D14**
1973
Use of non-wheat flours in bakery products
Getreide, Mehl und Brot, **27** (5), 170–176. (In German)

Early work in the use of non-wheat flours is reported, as is work at TNO (Netherlands) into the preparation of bread and baked goods entirely or partly from non-wheat flours. An acceptability study in Colombia is reported. Flours or starches used in the studies include cassava, soya, maize, sorghum, groundnut, millet and rice. Some formulae incorporating these materials are given.

RUSSOFF, I. I. *et al* **D15**
1964
Protein fortification of doughnuts
Fd Technol., **18** (11), 131–134

Doughnuts were manufactured containing 20% good quality protein. Toasted soya flour, de-fatted fish fillets and de-fatted whole fish protein were used, and the supplemented doughnuts were found to provide an adequate content and balance of essential amino acids; no impairment was found after deep-fat frying.

SIDWELL, V. D. & STILLINGS, B. R. **D16**
1961
Crackers fortified with fish protein concentrate (FPC)
J. Am. Diet. Ass., Sept. 1961, 270–280

The nutritional quality, sensory and physical characteristics of crackers fortified with 4, 8, 12 or 16% levels of FPC were studied. Levels of 4, 8, and 12% fortification had no significant effect on flavour, but the nutritive quality at 4% was 3 times that of the unfortified cracker (as measured by PER) and at 8%, nearly 4 times greater.

SILBERMAN, H. C. **D17**
1971
Enzymatic by-product conversion
USA Patent No. 3 615 721

An edible product can be prepared from by-products such as vegetables and fruits, or parts thereof, seeds, stems, grass, leaves and roots. The by-products are treated with an enzyme mixture, converted to a paste and formed into sheets or ribbons for storage. The edible product can be used in cakes, confectionery, biscuits and other foods.

SMITH, W. H. **D18**
1971
What can 'FQSF' do for you?
Snack Fd., **60** (6), 54–55

'Food quality soya flour' is finely milled from soya beans from which the husks and the 'bitter' principle have been removed. It confers good texture and longer shelf life on baked products. Its use in biscuits and crackers requires extra water.

Snack Fd., **60** (7), 53–57

The use of food quality soya flour in cookies, semi-sweet doughs, rotary and fermented doughs, sponge cakes, plain and fruit cakes is discussed.

SOLLARS, W. F. & RUBENTHALER, G. L. **D19**
1971
Performance of wheat and other starches in reconstituted flours
Cereal Chem., **48** (4), 397–410

Reconstituted flours, with starches from rye, barley, corn, rice and potatoes substituted for wheat starch, were subjected to cookie-baking, cake-baking and viscosity tests. Flours containing rye and barley starches proved very good for cakes and cookies, with viscosities close to those of wheat starch. Corn and potato starches were less satisfactory and rice starch very poor. The results indicate that certain physical and chemical starch properties are necessary for baking but that wheat starch is not unique in possessing them.

SUBRAHMANYAN, V. *et al* **D20**
1958
Manufacture of 'Nutro' biscuits
Res. and Ind., New Delhi, **3** (7), 178–179

The method is described whereby Nutro biscuits (containing 15–16% protein) are prepared from wheat flour, groundnut flour, calcium carbonate and vitamins. The biscuits are intended to supplement the diet of children, invalids and convalescents.

SUBRAHMANYAN, V. *et al* D21
1958
The effect of baking on the nutritive value of fortified biscuits
Fd Sci., **7** (4), 83–86

Fortified biscuits were prepared from a blend of wheat flour (35–40), groundnut flour (25–30), sugar, shortening, salt, calcium carbonate and glucose with added vitamins. Rats fed solely on the biscuits showed about the same growth rate whether the biscuits were baked or unbaked. Metabolism studies showed no significant reduction attributable to baking in the utilisation of protein, calcium, phosphorus and fat. Baking adversely affected the PER when the biscuits formed 10% of the protein intake.

TSEN, C. C. *et al* D22
1973
High-protein cookies. I. Effect of soya fortification and surfactants
Bakers' Dig., **47**, 34, 36–39

Fortification of wheat flour using soya flour or soya protein isolates results in an increase of 60–100% in the protein content of cookies. However, the spread is reduced considerably. This deficiency can be overcome by the use of sodium stearoyl-2-lactylate or sodium stearoyl fumarate. Less shortening is required with the use of the surfactants.

TVETSKOVA, L. F. *et al* D23
1972
Method of producing biscuits
USSR Patent 347 047. (In Russian)

Casein powder and gluten are added to the other ingredients in the proportion 20 wt. % and 30 wt. % of the total respectively. The product has enhanced protein content and optimum amino acid composition.

See also
A. 1:18:19
B. 21:23:24
Gb. 5:6
Gc. 2
Gd. 6:11
Hb. 2
He. 6:8
Ja. 1:39:41:47:57
Jb. 10:19:23:34:35:55:56
Jc. 1:4
Jd. 1:3:5:10
Jk. 4:5:14
Jm. 2:9:10:15:19–21:26
Jn. 3–5
Jo. 12:20
Jq. 1

Miscellaneous food products

BANIGO, E. O. I., DE MAN, J. M. & DUITSCHAEVER, C. L. E1
1972
Utilisation of high-lysine (opaque-2) corn for the manufacture of ogi (a traditional Nigerian fermented cereal food)
Cereal Sci. Today, 17 (9). Abstract only

0–2 corn was dry milled and ogi (the major breakfast cereal for adults and the major infant food) was prepared from the wholemeal flour. In attempts to reduce nutritional losses, a new dry-milling technique was used, with 76% recovery. The flour was then enriched with whey powder and fermented. Dry-milling eliminated almost all nutrient loss, and adaptation for large scale processing is proceeding.
(Shortened abstract)

HALLAB, A. H. & JABR, I. E2
1970
Nutritional value of Arabic bread fortified with soybean flour
3rd International Congress of Food Science and Technology, Washington, D.C., 1970

PRASANNAPPA, G. *et al* E3
1972
Pre-cooked Bal-Ahar and Indian multi-purpose food
J. Fd Sci. Technol. (India), 9 (4), 174–178

Composition and amino acid content are given for the blended raw materials of Indian multipurpose food (based on groundnut and Bengal gram) and Bal-Ahar (based on wheat, groundnut and skim milk powder). The ingredients were dry mixed and extrusion-cooked to prepare foods which were organoleptically acceptable. Figures are given for bulk density and water retention of raw and extruded blends, and for the consistency of the raw and cooked blends.

ZOHARY, M. E4
1962
Wild Bread
Plant life of Palestine, p. 213 New York: Ronald Press Co., 262 pp

The seed of *Chenopodium album*, which grows wild in Palestine, was used for the preparation of bread in years of famine. Dry seeds of *Mesenbryanthemum* are gathered by the desert tribesmen of Arabia, soaked in water and pounded to form a type of bread, while *Panicum turgidum* grains are collected in the Sahara, ground and baked into bread.

See also
C. 2
Gd. 10
He. 3
Jb. 14
Jd. 4
Jj. 6:7
Jn. 5

Pasta and grain substitutes

ANON F1
1971
Noodle production
Japanese Patent No. 42926/71 (In Japanese)

Flour compositions containing added raw gluten are used for the processing of noodles.

AJINOMOTO INC. F2
1971
Artificial rice product
British Patent No. 1 226 476

Starch, water and an amino acid are mixed, kneaded, and heated to gelatinise the starch granules partly. After further mixing and kneading with a binder, the product is formed into grains and dried. A waterproofing substance is applied to the surface of the grains.

AJINOMOTO INC. F3
1973
Noodle production
Japanese Patent No. 4807342 (In Japanese)

Waxy cornstarch is used at levels of up to 20% in the manufacture of noodles. On heat gelling the product yields an even texture, with decreased moisture absorption.

BAINS, G. S. *et al* F4
1954
Investigations on grain substitutes. II Storage quality of grains from blends of tapioca and groundnut
Bulletin, Central Food Technological Institute, Mysore, India, **3** (7), 183–186

Synthetic rice grains from tapioca and groundnut flours are hygroscopic, and the moisture content influences storage behaviour. Grain containing 7–11% moisture has stored well for 8–10 months. The product is fairly insect-resistant and offers no special storage problems as compared with natural rice, other than a susceptibility to excessive humidity.

BAINS, G. S. & PARPIA, H. B. F5
1967
Production, consumer acceptance and marketing of foodgrain substitutes of improved protein status
International Symposium on protein foods and concentrates, Central Food Technological Research Institute, Mysore, India

BHATIA, D. S. & SUBRAHMANYAN, V. F6
1959
Rice substitutes
Fd Sci. **8** (5), 161–167

The history of food substitutes is surveyed. The preparation of tapioca macaroni and its value as a rice substitute is described, with reports on the extension work and future outlook for the product.

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE F7
1954
Investigations on grain substitutes
Bulletin, Central Food Technological Research Institute, **3** (7) and **4** (3)

Part I Production of round grain from blends of tapioca and groundnut. (See F27)
Subrahmanyan, V. *et al,* **3** (7), 180–183.

Part II Storage quality of grains from blends of tapioca and groundnut. (See F4)
Bains, G. S. *et al,* **3** (7), 183–186.

Part III The nutritive value of round grains from blends of tapioca and groundnut flours. (See F28)
Subrahmanyan, V. *et al,* **3** (7), 187–189.

Part IV The biological value of the proteins of round grains from blends of tapioca and groundnut flours. (See F29)
Subrahmanyan, V. *et al,* **3** (7), 190–193.

Part V The nutritive value of synthetic rice. (See F30)
Subrahmanyan, V. *et al,* **4** (3), 55–57.

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE F8
1961
Studies on enriched tapioca-macaroni products
Fd Sci. **10** (12), 379–397

Part I Development of new formulations and pilot plant studies. (See F33)
Subrahmanyan, V. *et al.*

Part II Effect of processing on the PER. (See F36)
Venkata Rao, S. *et al.*

Part III Overall growth-promoting value. (See F16)
Gopalakrishna Rao, N. *et al.*

Part IV Effect of partial replacement of rice on the nutritive value of poor rice diet. (See F37)
Venkata Rao, S. *et al.*

Part V Supplementary value to the diet of weaned infants and young children. (See F11)
Doraiswamy, T. R. *et al.*

Part VI Supplementary value to the diet of school children. (See F12)
Doraiswamy, T. R. *et al.*

CLAUSI, A. S.
1971 F9
Cereal grains as dietary protein sources . . . . for developing highly acceptable high-protein foods
Fd Technol. **25** (8), 63–67

A General Foods Corporation project which was aimed at developing a low-cost, high-protein grain-based product for developing and developed countries resulted in a pasta product based on a blend of two cereal flours and soya flour, the ingredients being so balanced as to give the highest biological value commensurate

with processing ability. Mainly favourable reactions were obtained from consumer tests. Tables are included showing the high-protein foods sold in various countries and the cost of protein as found in different cereal grains.

DECKE, L. **F10**
1971
Farinaceous products for diabetics and production process
West German Patent Application 1 900 1977. (In German)

Noodles etc. are made from 100 parts by weight wheat semolina, 33 parts wheat gluten, 10 parts soya protein and 40 parts egg white. The product has a consistency comparable to that of conventional noodles, and a higher protein content.

DORAISWAMY, T. R. *et al* **F11**
1961
Studies on enriched tapioca-macaroni products. V Supplementary value to the diet of weaned infants and young children
Fd Sci. **10** (12), 389–393

Children from 8 to 36 months were given a 2-ounce supplement of enriched tapioca-macaroni twice daily for 6 months. 99 children took part in the experiment, being paired and allotted at random to one of three groups, two of which were the experimental groups. The mean increase in height, weight and haemoglobin level in these groups was significantly greater than in the control group.

DORAISWAMY, T. R. *et al* **F12**
1961
Studies on enriched tapioca-macaroni products. VI Supplementary value to the diet of school children
Fd Sci. **10** (12), 393–397

The supplementary value of 4 ounces daily of enriched tapioca-macaroni in the diet of school children aged 6–11 years was studied over a period of 4 months. The control group received 4 oz of non-enriched macaroni. The mean increase in height, weight and RBC of children in the experimental group was significantly higher, and improvement in nutritional status was greater, as compared with the control group.

DÜRR, P. and NEUKOM, H. **F13**
1972
Enrichment of pasta products with milk proteins
Lebensmittel-Wissenschaft & Technologie, **5** (4), 132–136 (In German)

Spaghetti enriched with milk proteins (rennet casein, acid casein, quarg and caseinate) was tested for cooking quality. The method of isolation of the protein from milk was found to affect the product; the milk protein concentrates must be incorporated in liquid form and should coagulate during the cooking of the enriched product.

FAGAN, M. S. **F14**
1972
High-protein pasta – a low cost, nutritious product to combat malnutrition
Cereal Sci. Today, **17** (9) (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only

A project was designed to produce a conventional form of food at a lower cost, using indigenous raw material and providing an improvement in nutrition. A vitamin and mineral enriched high-protein pasta made from a maize-soya-wheat flour blend was developed in the USA and Brazil, with 7 times the protein rating,

and with lower manufacturing costs as compared with the conventional product. Consumer ratings were favourable, and the capital investment necessary is small.

(Shortened abstract)

GLABE, E. F., ANDERSON, P. W. & MURAWSKI, G. M. **F15**
1970
Macaroni products

USA Patent No. 3 544 333

Macaroni products contain 30% (by weight) of non-fat dried milk and Iota type Carrageenan in sufficient concentration to improve cooking stability and texture.

GOPALAKRISHNA RAO, N. *et al* **F16**
1961
Studies on enriched tapioca-macaroni products. III Overall growth-promoting value

Fd Sci. **10** (12), 383–385

Overall growth-promoting values for tapioca-macaroni products as described in Part I were estimated by the rat-growth method. Diets based on steamed and unsteamed A and B Blends promoted high average weight gains at 90% protein intake. Steaming had no significant effect. Sole diets of Blends C and D also gave high weight gains, with low fat in livers. Blend A was superior to a proprietary cereal food tested for comparison.

JOSEPH, K. *et al* **F17**
1958
The effect of replacing rice in the diet by tapioca-macaroni on the metabolism of nitrogen, calcium and phosphorus in children

Fd Sci. **7** (9), 253–254

Replacement of rice in the diet of children with tapioca-macaroni resulted in an increase in the retention of nitrogen, calcium and phosphorus, but the difference between experimental and control groups was not statistically significant.

MATSUO, R. R., BRADLEY, J. W. & IRVINE, G. N. **F18**
1972
Effect of protein content on the cooking quality of spaghetti

Cereal Chem. **49** (6), 707–711

A number of durum wheat varieties of varying quality were studied for the preparation of spaghetti, and in all cases cooking quality improved with increasing protein content. Proteins from rapeseed meal, fish protein concentrate, soya flour and egg albumin, as well as protein components from durum wheat were also used to supplement semolina for spaghetti production, and the most pronounced improvement in cooking quality was found with egg albumin and with glutenin. Gliadin also improved the quality, whereas proteins from other sources had little effect.

NARAYANAN, N. *et al*
1960 **F19**
Effect of processing on the nutritive value of "Nutro" macaroni (protein-enriched macaroni)

Fd Sci. **9** (7), 159–162

During manufacture under regulated temperature and humidity, the B-vitamins in Nutro macaroni (80% wheat semolina and 20% low-fat groundnut flour fortified with vitamins and calcium) suffered no appreciable destruction. Cooking with the minimum amount of water reduced loss of nutrients, and 8–9 minutes of cooking gave no appreciable loss of B-vitamins.

RAJASEKHARAN, N. *et al* F20
1960
Keeping quality of tapioca and "Nutro" macaroni
Fd Sci. 9 (7), 240–243

Storage trials for one year on steamed and roasted tapioca, macaroni rice and Nutro macaroni (shells) packed in different containers showed that all the products have good keeping quality under normal conditions, and are fairly resistant to insects.

SCHARSCHMIDT, R. K., AUBEL, L. F. & KAPLAN, M. F21
1971
High-protein pasta
USA Patent No. 3 615 677

High-protein low-cost pasta products are prepared from blends of 45–85% maize flour, 15–40% soya flour and 0–30% wheat flour.

STAUB, H. W., REUSSNER, G. & THIESSEN, R. F22
1970
Protein quality of a novel high-protein pasta
3rd International Congress of Food Sci. and Technol., Washington, D.C., 1970

STEPCHKOV, K. A. *et al* F23
1970
Improving the technological properties of flour having a low gluten content
USSR Patent 275 000 (In Russian)

The food value of macaroni products is increased by incorporation of an edible protein preparation obtained from yeast by fermentation hydrolysis.

SUBRAHMANYAN, V., RAMA RAO, G. & SWAMINATHAN, M. F24
1950
Investigations on the preparation, properties and nutritive value of rice substitutes from tubers and millets
J. scient. ind. Res., 9B (10), 259–61

Substitutes for rice can be prepared from maize and tapioca flours. Products obtained from a mixture of tapioca and groundnut cake flours were light-brown in colour but proved quite acceptable when cooked on their own or with rice.

SUBRAHMANYAN, V. *et al* F25
1954
Grain substitutes
Bulletin, Central Food Technological Research Institute, Mysore, India, 3 (7), 162–165

Shortages of rice prompted investigations into 'synthetic rice' in Mysore. There were already seven commercial products of this nature on the world market, such as 'mock rice' and 'barley rice'. The Mysore workers selected a cheap and plentiful raw material, tapioca flour, and as an added source of protein, groundnut flour, blending them in the proportion 85:15. The process of manufacture is described, and a table shows the analytical data of some rice substitutes as compared with natural rice.

SUBRAHMANYAN, V. *et al* F26
1954
Rice substitutes
Nature, Lond. 174 (4422), 199–201

A report on the history of the search for cheap and plentiful materials which could be used as substitutes for rice; the processing of cassava and groundnut into flours suitable for the purpose; the properties and nutritive value of the blend and the outlook for the future.

SUBRAHMANYAN, V. *et al* F27
1954
Investigations on grain substitutes. I Production of round grain from blends of tapioca and groundnut
Bulletin, Central Food Technological Research Institute, Mysore, India, **3** (4), 180–183

The paper reports on the preparation, palatability and economics of synthetic rice grains produced from tapioca and groundnut flours.

SUBRAHMANYAN, V. *et al* F28
1954
Investigations on grain substitutes. III The nutritive value of round grains from blends of tapioca and groundnut flours
Bulletin, Central Food Technological Research Institute, Mysore, India, **3** (7), 187–189

Rat-growth assay established that the nutritive value of diets based on 85:15 and 80:20 tapioca: groundnut flour were equal to wheat and ragi (*Eleusine coracana*) diets, superior to rice and jowar (*Sorghum vulgare*) diets and of definite supplementary value to diets of rice, wheat, jowar and ragi.

SUBRAHMANYAN, V. *et al* F29
1954
Investigations on grain substitutes. IV The biological value of the proteins of round grains from blends of tapioca and groundnut flours
Bulletin, Central Food Technological Research Institute, Mysore, India, **3** (7), 190–193

The biological value of the proteins of round grains made from 80:20 tapioca: groundnut flour was determined at 5 and 10% levels of intake. At 5% intake the BV was less than that of rice protein, but at the 7.5 and 10% levels was approximately equal to wheat protein.

SUBRAHMANYAN, V. *et al*
1954 F30
Investigations on grain substitutes. V The nutritive value of synthetic rice
Bulletin, Central Food Technological Research Institute, Mysore, India, **4** (3), 55–57

Rat-growth assay was used to determine the overall nutritive value of poor vegetarian diets based on raw milled rice (A), synthetic rice (60% tapioca, 15% groundnut and 25% wheat) (B), and synthetic rice grains coated with calcium caseinate (C). B and C were significantly superior to A in overall growth promotion; animals fed on A failed to reproduce whereas this was not the case with diets B and C.

SUBRAHMANYAN, V. *et al* **F31**
1958
The effect of replacement of rice in a poor vegetarian diet by tapioca-macaroni on the general health and nutritional status of children
Br. J. Nutr. **12** (4), 353–358
See also *Fd Sci.* **7** (4), 87–89

A 6-month diet experiment was conducted with 32 girls between 4 and 11 years old to compare the nutritive value of rice with that of tapioca macaroni (60 tapioca, 15 groundnut, 25 wheat semolina). The results indicated equal health and growth and improved nutritional status for the children fed on tapioca-macaroni.

SUBRAHMANYAN, V. *et al* **F32**
1958
Tapioca-macaroni: pilot plant production
Res. and Ind, New Delhi, **3** (10), 270–275

A pilot plant at Mysore can produce one ton per diem of tapioca-macaroni, containing tapioca, groundnut flour and wheat semolina in the proportions 60:15:25. The steps involved in the manufacture are: grinding, dry-mixing, dough-formation, extrusion, pre-drying, heat conditioning, steaming and curing.

SUBRAHMANYAN, V. *et al* **F33**
1961
Studies on enriched tapioca macaroni products. I Development of new formulations and pilot plant studies
Fd Sci. **10** (12), 379–381

Macaroni-type products, fortified and palatable, were formulated from four blends of cassava flour, groundnut flour and wheat semolina. Blend B contained the basic three flours only. Blend A also contained casein; Blend C contained NFM powder; Blend D contained chickpea flour. All were fortified with vitamins and minerals. The preparation of the raw materials and the pilot plant production methods are described. The chemical composition of the product is tabulated.

TOSELLO, A. **F34**
1973
The cereal needs in South America. Technological problems encountered
Cereal Sci. Today, **18** (9) (58th Ann. Meeting, American Assn. Cereal Chemists) Abstract only

Population growth and urbanisation has led to increased consumption of wheat, at the expense of tubers and roots, mainly in the form of bread and macaroni. The technological problems involved in replacing wheat in these products with other flours such as maize, soya and cassava are being investigated by research programmes and private industry.
(Shortened abstract)

VALLALAT, T. E. **F35**
1971
Preparation of low-carbohydrate high-protein bread rolls and pasta
West German Patent No. 1 442 021

Fine edible casein is added to the flour either before mixing or during the baking and cooling processes. The flavour and physical characteristics of the dough are not affected by the addition of 20–100% (on flour weight) of casein.

VENKATA RAO, S. *et al* **F36**
1961
Studies on enriched tapioca-macaroni products. II Effect of processing on the protein efficiency ratio
Fd Sci. **10** (12), 381–383

Studies were made of the effect of heat processing on the PER of the four blends of enriched tapioca-macaroni listed in Part I. With all four blends, the untreated product gave a higher PER than the treated product when fed to rats at 10% of protein intake level. The PER differences between treated and untreated products were statistically significant for blends C and D, and not for blends A and B.

VENKATA RAO, S. *et al* **F37**
1961
Studies on enriched tapioca-macaroni products. IV Effect of partial replacement of rice on the nutritive value of poor rice diet
Fd Sci. **10** (12), 386–389

A mix of rice and enriched macaroni (36:54) promoted almost the same growth rate in albino rats as a blend of rice and whole-milk powder (54:36). Other experiments to compare the growth rate on varying diets of rice, enriched macaroni and milk powder indicated the value of partial replacement of rice with enriched macaroni, and that the mean N-content of rat livers on diets containing macaroni was similar to those obtained with milk powder diets.

WIE HAN KWEE *et al* **F38**
1969
Quality and nutritive value of pasta made from rice, corn, soya and tapioca enriched with fish protein concentrate
Cereal Chem. **46** (1), 78–84

FPC was added to pasta flours of rice, corn, soya and tapioca and the result assessed organoleptically, objectively, and in animal feeding studies. Both the 10 and 20% levels of FPC addition improved the nutritional value, and rice pasta appeared to be the most acceptable. Of the other base flours, tapioca seemed the most promising, giving a more attractive colour, but its texture softened too much during cooking.

WINSTON, M. E. & WINSTON, J. S. **F39**
1972
Effect of protein additives on pasta
Tecnica Molitoria, **23** (14), 486–490

Using 100% hard wheat as control, the colour of pasta was studied when the following materials were added in various proportions: wheat germ, oat flour, maize germ, casein, ascorbic acid, citric acid, $KBrO_3$ KIO_3, $NaHSO_3$ and SO_2. 95% wheat flour with 5.0% casein gave a better colour than 100% wheat flour, and a comparable colour was obtained with 90% wheat, 5% oat and 5% casein. Both these experimental mixes also gave good quality pasta.

WOO, H. C. & ERDMAN, A. M. **F40**
1971
Fish protein concentrate enrichment of noodles
J. of Home Economics, **63** (4), 263–265

The nutritional value of noodles enriched with 10 and 15% FPC was assessed by rat-feeding trials. Protein content was found to be 17.5% and 19.9% respectively, as compared with 10.4% for the control. Weight gain in rats was highest at the 15% level, whereas the 10% level was the most acceptable in sensory tests on children.

See also
Gb. 8
Gc. 2
Gj. 2
Hb. 11
Ja. 63:70
Jb. 10:13:18
Jn. 2:7
Jo. 11

Cereals

General

LUBIG, R. **Ga1**
1970
Method for producing black rye bread
West German Patent Application 1912 933 (In German)

52–61 litres of boiling water are added to 100 kg mixed cereals, e.g. rye, barley, maize, rice. After cooling for 12 hours, 20 litres leavening, containing lactic acid, are added, followed by kneading for 1 hour and baking for 24 hours at 105–120°C. The bread has a high nutritional value. The leavening is based on buttermilk or whey, and these may also replace the water for mixing.

SPRIGGS, E. I. & WEIR, A. B. **Ga2**
1917
The digestibility of bread made from two parts wheat and one part oats, barley, maize or rice
Lancet, Nov. 10, 1917, pp 724–6

If properly prepared and baked, palatable breads can be made from a mixture of two thirds wheat flour and one third oats, barley, maize or rice. Each of the breads, taken in a mixed diet, was as nourishing as all-wheat bread.

See also
A. 18
B. 9

Maize

ANON **Gb1**
1965
Some notes on the corn loaf approach
S. Afr. Baker Miller **33** (1), 5–6

Research into the use of 25% maize flour in bread was initiated at the National Nutrition Research Institute as there was local over-production of maize, whereas wheat was being imported. Specific improvers were tried and it was found that a good quality 25/75 bread could be made, provided that 10g baker's fat and 50mg ascorbic acid or potassium bromate were added per kg flour.

BALLSCHMEITER, H. M. & VLIESTRA, H. **Gb2**
1963
Use of maize flour in wheat bread
Brot Gebäck, **3,** 44–52 (In German)

Experiments were carried out on the use of maize flour in leavened wheat bread. Bread containing 25% maize flour was improved by the addition of ascorbic acid or potassium bromate and 1% baking fat. Optimum quantities of ingredients are required for a good quality of product, and 50 mg/kg flour of ascorbic acid or potassium bromate are necessary. Extra screened granulated maize flour is most suitable; finely milled maize flour is unsuitable.

BALLSCHMEITER, H. M. B. & VLIESTRA, H. **Gb3**
1965
The use of milled maize products in making bread from wheat flour
Brot Gebäck, **19** (8), 153–158

Wheat starch is necessary for the baking of gluten-containing maize bread, but can be replaced by potato starch without affecting bread volume significantly. Special sifted granulated maize flour was better than fine maize flour. The water-soluble components of wheat flour did not affect the baking properties of the bread; gluten washed with water gave the same performance as gluten washed with phosphate buffer.

BALLSCHMEITER, H. M. B. & VLIESTRA, H. **Gb4**
1968
Yeasted white loaf containing 50% maize
Brot Gebäck, **22** (4), 66–71 (In German)

It was found possible to produce a good quality yeasted bread containing 50% wheat and 50% maize flour if the dough was made up with L-ascorbic acid (optimum 50 mg/kg), alpha-amylase (optimum 6 mg/kg), 2% baking fat and 3% compressed yeast. The quality of the wheat flour must be good or average for good results.

BELSHAW, F.
1972 **Gb5**
Special starch simplifies nutritional snack preparation
Food Processing, **33** (11), 40–41

Waxy corn starch, which swells in cold water, is used in crackers and baked snacks. The doughs may incorporate protein isolates or concentrates, potato granules or cheese powders.

BLESSIN, C. W. *et al* **Gb6**
1973
Updates applications of corn germ flour
Fd Engng. **45** (4)

De-fatted corn-germ flour was added to cookies, muffins and ground beef. The flour contained 25% protein, 4% fibre, 10% ash. Results of baking trials and sensory evaluations are presented.

BOOKWALTER, G. N., KWOLEK, W. F., BLACK, L. T. & GRIFFIN, E. L. **Gb7**
1971
Cornmeal/soy flour blends: characteristics and food applications
J. Fd Sci. **36** (7), 1026–1032

Protein quality and quantity of degermed maize meal were improved by supplementation with toasted de-fatted soya flour; even addition levels of 20% produced no significant change in taste panel reactions. Flavour stability was adequate at additions at the 15% level of toasted de-fatted, commercial-processed-full-fat or extrusion-cooked-full-fat soya. Chapati and Northern maize bread were satisfactory with 15% toasted-de-fatted, 20% processed-full-fat or 35% extrusion-cooked-full-fat soya flours. Full-fat soya caused less colour change than toasted de-fatted soya.

de BUCKLE, S. T. **Gb8**
1972
Opaque maize in the food industry
Revista del Instituto de Investigaciónes Tecnológicas, Bogatá, Colombia, **14** (77), 33–50 (In Spanish)

Pilot scale studies of the suitability of opaque-2 maize in the commerical production of Colombian foods gave the following results.

(i) Arepas resembled the traditional product except in flavour which, though different, was pleasant.
(ii) 50/50 wheat/raw 0-2 maize flour blend was too brittle for pasta manufacture, but when the maize was pre-cooked or incorporated at 20–50% the product was satisfactory.
(iii) 30% coarse raw 0-2 maize with 0.5% CSL was satisfactory in bread. Nutritional value was increased in all cases.

CANUTI, A. **Gb9**
1969
Maize in macaroni products
Tecnica Molitoria, **20** (22), 627–638 (In Italian)

The structure, composition and uses of maize, and methods of manufacturing macaroni products from predigested or dextrinised maize are reported. The improvement in nutritive value by predigestion is discussed.

ELIAS, L. G. & BRESSANI, R. **Gb10**
1972
Technological improvement of protein quality of maize
Tecnologia de Alimentos, **7** (2), 70–77, 80–81, 84–86 (In Spanish)

Presented at the Food Technology Congress, Mexico, 1971 this report reviews the fortification of maize with soya flour and lysine, and discusses the application of such fortification in Latin America.

FELDBERG, C. **Gb11**
1965
Corn gluten, a new ingredient for bakery products
Cereal Sci. Today, **10** (1), 18–19, 28

Preliminary studies on a variety of baked goods indicate that corn gluten at low levels improves colour, crumb moistness, moisture retention and tenderness, with resulting improved storage stability. The use of corn gluten in a number of baked products is outlined, and formulae are given.

LITTLEWOOD, A. **Gb12**
1964
Corn bread
Baker Confectr. **146** (7), 215, 216, 218

Recipes for bread and rolls made from wheat and maize flour are given, with emphasis on the use of yellow maize flour to obtain a distinctive colour. The proportions of maize to wheat vary in the recipes from 4:10 to 6:8.

MATTHEWS, R. H., SHARPE, E. J. & CLARK, W. M. **Gb13**
1970
Some functional properties of processed corn meal related to use in bread, beverages and porridges
Cereal Sci. Today, **15** (7), 208–210

Two processed maize meals and one uncooked were compared at various levels of wheat flour replacement in bread doughs and as an ingredient for beverages or porridge. Absorption, mixing tolerance, starch gelatinisation and loaf volume are given. Overall bread quality was fair to good with all maize meals tried, at all the levels of replacement.

NOZNICK, P. P., MERRITT, P. P. & GEDDES, W. F. **Gb14**
1946
Staling studies on bread containing waxy maize starch
Cereal Chem. **23** (3)

Bread was baked from gluten/starch mixtures where the starch consisted of mixtures of wheat starch and various quantities of waxy maize starch. Complete substitution of wheat starch by waxy maize starch gave loaves with compressible crumb and excessive shrinkage after baking. Crumb compressibility and crumb swelling capacity, measured 3 hours after baking, were increased with substitution of waxy maize starch for wheat starch. On storage, crumb compressibility of loaves containing maize starch decreased at about the same rate as loaves made from mixtures of gluten and wheat starch. The results suggest that staling is associated with changes in the branched chain component (amylopectin) of wheat starch.

de OLIVIERA, J. E. D. and Da SILVA, M. L. P.
1971 **Gb15**
Nutritive value of opaque-2 corn and its mixture with hybrid corn and wheat flour
J. Fd Sci. **36** (3), 370–371

The nutritive value of opaque-2 corn (high lysine high tryptophan maize) grown in Brazil was estimated, as were the nutritional effects of its addition to hybrid maize and wheat flour. The hybrid maize was little affected but better results were achieved with wheat flour.

RANHOTRA, G. S. **Gb16**
1972
Use of opaque-2 corn flour with white wheat flour
J. agric. Fd Chem. **20** (6), 1136–1137

Replacing wheat flour with up to 35% opaque corn flour increased the protein efficiency ratio (PER) by up to 0.34; and replacing the wheat flour with 30% wheat protein concentrate (WPC) or 15% corn flour plus 20% WPC increased the PER by 0.39. Increased protein quality was accompanied by substantial impairment of bread-making quality when corn was used at levels exceeding 20%.

SUTESCU, P. *et al* **Gb17**
1972
Increasing nutritive value of bread by maize germ addition
Igiena, **21** (11), 647–654 (In Rumanian)

Organoleptic quality, volume, porosity, moisture and acidity were similar in control bread and breads containing 3 or 6% whole maize germ. PER trials in rats indicated that the addition of 6% maize germ improved the amino acid balance of the bread.

TOLLEFSEN, B. **Gb18**
1967
New milled corn products, including CSM
Cereal Sci. Today, **12** (10), 438–441

A report on the USA aid programmes distributing protein-enriched corn-based products to developing countries. De-germed corn meal, processed corn meal, CSM (Corn, Soya, Milk solids) and Celapro are described, as are the areas where these products are particularly suited to local habits and tastes.

VOJNOVIC, V. **Gb19**
1969
Effect of added maize flour on the farinological properties of wheat flour dough
Hrana i Ishrana, **10** (11/12), 619–629 (In Serbo-Croat)

Maize flour admixed with 4 different wheat flours at levels of 5, 15 or 25% caused a drop in water absorption capacity and in dough strength and an increase in fermentation capacity. The effect increased with increasing increments of maize flour.

ZAHARIA, T. **Gb20**
1973
The quality of bread supplemented with maize flour and other ingredients
Igiena, **22** (1), 11–17 (In Rumanian)

Substitution of 3% of wheat flour with a mixture of maize flour, potato flour, lecithin and wheat germ gave an acceptable bread with a longer shelf-life than wheat/potato bread. Superiority in nutritive value over wheat/potato bread was not statistically significant, but the nutritional efficiency was significantly enhanced by addition of 4g $CaCO_3$ per kg flour.

See also

A. 14:22
B. 2:6:13:18:23:24:26:28:29:36
D. 4:7:8:13:14:19
E. 1
F. 3:14:21:24:34:38:39
Ga. 1:2
Gd. 2:6
Ge. 1
Gj. 1
Gk. 1
Hb. 5
Ja. 17:29:35–37:46:60:64
Jb. 13:14:45
Jd. 7
Jk. 6
Jm. 16:17
Jo. 1:2:4:6:10:18

Rice

BORASIO, L. **Gc1**
1931
Rice flour in breadmaking: conclusions and deductions
G. Risic. **21** (4), 55–59 (In Italian)

With strong, finely-milled wheat flours it was found possible to incorporate high levels of rice flour and obtain good quality bread. The rice flour must, it is stated, be milled from the whole grain, so that the major nutritive substances are retained, as these stimulate the action of yeast enzymes. Fine rice types are not recommended and the author considers that the Originario type is best suited for rice flour. Breadmaking with rice flour presents no difficulties and variations in baking procedure are given which facilitate the production of various types of bread.

BORASIO, L. **Gc2**
1931
Breadmaking and baking with admixture of rice flour
G. Risic. **21** (9), 136–139 (In Italian)

Bread was made with 5 to 15% rice flour and pastries with 50 to 60%. Fine brown rice is recommended; coarse flour causes imperfect incorporation and poor fermentation. In pasta the percentage of rice flour should be varied according to the processes involved.

BORASIO, L. **Gc3**
1931
Convincing breadmaking experiments with admixture of brown rice
G. Risic. **21** (11), 169–173 (In Italian)

KIKKOMAN SYOYU CO. LTD. **Gc4**
1973
Wheat-rice bread
Japanese Patent No. 2779/73 (In Japanese)

Bread is made from a mix of wheat flour with up to 30% rice powder obtained from grinding puffed rice.

KOIZUMI, N. *et al* **Gc5**
1971
Enrichment of rice with L-lysine and change of flavour and taste in cooked rice by L-lysine
J. Jap. Soc. Fd Nutr. **24** (6), 325–330 (In Japanese)

Studies were made of the effect on the flavour of aged brown rice of the addition of L-lysine, in attempts to improve the eating quality of surplus rice remaining from previous crops. Chemical and sensory studies showed that 80% of the L-lysine was retained during cooling and that the flavour was significantly improved.

KYONO HAKKO KOGYO CO. LTD. **Gc6**
1970
Enriched rice
British Patent No. 1 211 062

Pre-soaked rice grains are steamed, dried and soaked in dilute acetic acid. After further drying the grains are soaked in an aqueous amino acid solution.

LOVELL, L. **Gc7**
1961
Development of a wheat-and-rice bread for use in home baking
Arkansas Farm Res., **10** (1), 11

MITSUDA, H. **Gc8**
1969
Storage and nutritional improvement of rice grain
J. Jap. Soc. Fd Nutr. **22** (3), 127–130 (In Japanese)

Rice provides 30% of protein and 60% of calorie intake in Japan. Lysine can be used to enrich rice by a double-soaking method developed by the author, eliminating staleness after storage and improving the flavour of the cooked rice. Packaging in laminated plastic bags enables husked or brown rice to be stored underground or underwater.

MOSQUEDA-SUAREZ, A. **Gc9**
1958
A new type of bread: wheat-and-rice bread
Fd Technol. **12** (15), 15–17

30% wheat flour was replaced with rice in baking trials. The PER increased by 9.1% although the composite flour contained less protein, and the amino acid pattern was thought to account for the greater protein efficiency. The wheat/rice bread requires 25% more yeast. It can improve the economy where rice is an indigenous crop and wheat is not.

NAGAMATSU, N. & TAKECHI, Y. **Gc10**
1972
Rice bread
Japanese Patent No. 31621/72 (In Japanese)

Improved quality in rice bread is claimed for a product incorporating gluten and chlorella extract liquor.

ROBERTS, R. L.
1971 **Gc11**
Rice investigations at Western Regional Research Laboratory
Rice J. **74** (6), 40–42

Recent rice research at WRRL is reviewed. Subjects dealt with include rice bread and high protein rice flours.

SENDOYA, G. S.
1970 **Gc12**
Technological properties of three varieties of rice
Revta Inst. Invest. Technol. Bogotá, Colombia, **68**, 18–34

Tables illustrate the results of studies on 3 varieties of rice, Tapuripa, Bluebonnet and IR8. Differences in chemical composition of the grains were not significant. Breadmaking experiments, substituting the rice varieties for wheat flour, depressed

loaf volume with increasing substitution levels. The addition of calcium stearoyl lactylate relieved the deleterious effect. Differences between varieties was most pronounced at the 10% level of substitution. Some bread characteristics were improved by 10% rice plus CSL in the case of all three varieties.

SPADARO, J. J., MOTTERN, H. H. & GALLO, A. S. **Gc13**
1971
Extrusion of rice with cottonseed and peanut flours
Cereal Sci. Today **16** (8), 238

Commercially milled brown and white rice was cracked and extruded with 20% LCP cotton seed flour, with 10 and 20% glandless cotton seed flour and with 10, 15 and 20% defatted groundnut flour. The dried collets from the mixtures of brown rice and defatted groundnut flour were given very favourable flavour-ratings. The other blends were not rated so highly. An expressed mixture of yellow corn grits with 20% glandless cotton seed flour was not acceptable in flavour.

TANAKA, Y. **Gc14**
1972
Quality improvement of rice bread
Jap. agric. Res. Q. **6** (3), 181–187 (In Japanese)

Replacement of wheat flour with rice flour leads to a reduction in loaf volume, but various surfactants can restore dough and loaf characteristics to normal levels. The use of a little bacterial alpha-amylase with high heat resistance was beneficial. Rice flour with large particles was more satisfactory than milled, parched or puffed rice flour, and at a 10% level of substitution, extension of the final proofing time resulted in a loaf of the same volume as that from 100% wheat flour.

WAKEFIELD, L. M. & ROWLANDS, R. **Gc15**
1973
Protein quality of rice polish and combinations with peanut flour, fish protein concentrate, and lysine
Cereal Chem. **50**, 428–433

Assessment of proteins by cumulative weight gain, protein efficiency ratio (PER), biological value (BV), and digestibility coefficient (DC), indicated rice polish as an effective means of increasing BV and PER in animal feeding experiments. DC indicates possible use of rice polish as a source of protein in India's diet. Rice polish and a protein concentrate had highest BV in this study. Rice polish unused in India may have market potential alone or blended with fish flour as a protein source.

See also
A. 14:18:26
B. 6:11–13:26
D. 7:14:19
F. 24:28:30:37:38
Ga. 1:2
Gh. 3
Gk. 1
Ha. 1
Hb. 6
Ja. 17:63:64
Jb. 45
Jk. 11
Jo. 18

Sorghum

ARNOULD, J. P. & MICHE, J. C. **Gd1**
1971
Aperçu sur l'économie et l'utilisation des mils et sorgo dans le monde
Communication présentée au symposium sur les farines composées a Vienne, (Study Group 32: 1CC) 1971. IRAT, 110 Rue de l'Universitée, Paris (7^{e})

AVANZI, E. & GRAFF, G. **Gd2**
1939
Flour from sweet sorghum and maize in fermented bread
Industria saccar. ital. **32** (5), 273–278 (In Italian)

Bread with 5% maize and sorghum differed hardly at all from all-wheat bread; 10% addition still gave good bread; with 15% the quality was poorer due to difficulty in fermentation. Results can be improved by modifications in mixing, fermentation and baking.

BORASIO, L. **Gd3**
1937
Sorghum as a food and as a substitute in breadmaking
G. Risic. **27** (1), 7–12 (In Italian)

The position of sorghum in the history and culture of Africa and Europe is discussed. Analyses comparing various sorghum varieties with each other and with other cereals are tabulated. Also tabulated are characteristics of bread containing different levels of durra and sweet sorghum.

CAVINS, J. F., BLESSIN, C. W. & INGLETT, G. E. **Gd4**
1972
Infusion of grain sorghum with lysine, methionine and tryptophan
Cereal Chem. **49** (5), 605–608

A wide range of adjustment in the amino acid balance of sorghum grains can be achieved by infusion techniques; factors affecting the level of infusion being amino acid solubility, time, temperature, and concentration of the infusion solution. Infusion of part of a batch to a high concentration followed by blending, is an alternative to infusion of the whole batch of grains.

DENDY, D. A. V., JAMES, A. W. & CLARKE, P. A. **Gd5**
1971
The use of sorghum as a diluent for wheat flour in breadmaking
Sorghum Newsletter **14**, 22

One red and one white sorghum from the Sudan were milled at 80% extraction and used to dilute strong wheat flour at levels of up to 30% using mechanical dough development. Loaf volume and crumb were similar for each sorghum but the red variety gave a darker colour. Up to 15% could be used with little loss of volume.

ELLIOTT, J. S. & McPHERSON, C. M. **Gd6**
1971
Nutrient values of and consumer preference for grain sorghum wafers
J. Am. Dietetic Ass. **58** (3), 225–229

A high-protein low-fat grain sorghum snack food was developed in the form of a wafer containing sorghum flour, brewer's yeast, soya bean protein, salt, egg, vegetable oil, methyl cellulose and water. The product was compared with corn, potato and tortilla chips and proved to have 5 to 6 times as much protein and less fat.

HART, M. R. *et al* **Gd7**
1970
Bread from sorghum and barley flours
J. Fd Sci. **35** (5), 661–665

Various additives were examined as possible aids in making bread from sorghum and barley flours. These included several gums (especially effective was 4000 centipoise methylcellulose), several starches, glycerol monostearate and shortenings.

INSTITUT DE RECHERCHES AGRONOMIQUES TROPICALES **Gd8**
1971
Les travaux de l'IRAT en matière d'amélioration du sorgo et du mil
110, Rue de l'Universitée, Paris (7^{e})

(1) Importance du sorgo et du mil dans le monde et en Afrique.
(2) Problèmes posés par l'amélioration du sorgo et du mil.
(3) Orientation donnée par l'IRAT à ses recherches sur le sorgo et le mil.
(4) Organisation et articulation des moyens—collaborations extèrieures.
(5) Resultats et perspectives.

MILLER, O. H. & BURNS, E. E. **Gd9**
1970
Starch characteristics of selected grain sorghums as related to human foods
J. Fd Sci. **35** (5), 666–668

Seventeen varieties and hybrids of grain sorghum were analysed and correlation between the results and organoleptic quality was made. Varieties high in amylopectin were preferred for sorghum bread.

MUSTAFA, A. M. I. **Gd10**
1973
Production of bread from composite flour
Sudan J. Fd Sci. Technol. **5**, 41–45

Consumption of wheat bread is replacing consumption of kissra, a flat fermented sorghum (maize) dough, with a resulting rise in the import of wheat. Acceptable bread could be prepared from a wheat/sorghum blend in the proportion 9:1. Extacted sorghum flour could replace wheat in higher proportion, and better wheat could accept more sorghum flour. Crumbless bread is recommended as it can accept more non-wheat flour and avoid crumb waste. Other non-wheat flours are under investigation.

PERCY, P. F. & ABU ZEID, Y. (Editors) **Gd11**
1971
Annual report on research, extension and training, July 1970–June 1971
Ministry of Agriculture, Dept. of Horticulture, Food Research Centre, Shambat, Sudan. (FAO/UNDP Project, Sud/70/514)

Varieties of sorghum and millet were tested in breadmaking at rates of 10–30%. Best results were obtained with 10% milo and 5% groundnut paste. Addition of sesame paste gave unacceptable bread. Crumbless bread and biscuits were also tested.

See also
A. 8:16
B. 11:13:17:18:25:34:36:38
D. 11:14
F. 28
Ge. 2
Hb. 2
Ja. 29
Jo. 18
Jp. 3

Millet

MANGAY, A. S., PEARSON, W. N. & DARBY, W. J. **Ge1**
1957
Millet (*Setaria Italica*): its amino acid and niacin content and supplementary value for corn (maize)
J. Nutr. **62**, 377–393

Microbiological analyses suggested that Italian millet was deficient in lysine but high in tryptophan. The addition of 1% lysine to a diet of 40% maize + 40% millet improved rat growth considerably, but no such response was obtained when lysine was added to a diet of 80% maize + 10% millet unless niacin and tryptophan were also added. As millet is added to a maize diet the deficiency in niacin, tryptophan and lysine becomes a deficiency of lysine alone. Four varieties of millet grown in Africa and India were found by other workers to be relatively rich in lysine and limiting in tryptophan.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION **Ge2**
1971
Bread before cakes is good for national economy
UNIDO Press Release, Feature No. 4, 2pp.

The press release relates the experiences of a UN bakery consultant in Chad, who initiated the use of up to 50% of local millet and sorghum to replace imported wheat. It was found that machinery designed for wheat was equally suitable for sorghum and millet. Loaves containing 40% millet flour were sold at 30% less than all-wheat bread.

See also
A. 17
B. 11:13:15:18:24:34:36:38
D. 11:14
F. 28
Gd. 1:8:11
Gm. 1
Jj. 2
Jo. 18

Barley

FERREL, R. E., MOSSMAN, A. P. & WASSERMAN, T. **Gf1**
1973
Steam-processed wheat and barley for use in fortified food blends
Cereal Sci. Today **18** (6), 154–157

Wheat and barley can be processed to produce a satisfactory cereal base for fortified foods. A broad range of cold- and hot-paste viscosity characteristics can be obtained by controlling grain moisture during steaming.

See also
A. 14
B. 6
D. 7
Ga. 1:2
Gd. 7
Gj. 1
Jk. 11

HABEL, H. **Gg1**
1971
Process for making bread with oat products, particularly oat flakes, which are added in dry form to leavened dough

West German Patent Application, 2 026 382 (In German)

Dry oats are added to leavened dough containing wholemeal flour or milled products, together with other supplements such as linseed, milk or calcium. The bread, which has dietetic or medicinal properties, stores well and retains its flavour.

See also
B. 6
D. 9
F. 39
Ga. 2
Gk. 1
Ja. 35:64
Jk. 11
Jo. 7

Rye

JANICKI, J., WARCHALEWSKI, J. & STASINSKA, B. **Gh1**
1971
Analysis of amino acid composition of selected types of bread
Przeglad Piekarski i Cukierniczy, **19** (5), 112–114 (In Polish)

Chemical composition, amino acid content and protein value of rye/wheat, all-wheat and all-rye breads were estimated. N protein and individual amino acid contents were highest in all-wheat bread, followed by wheat/rye bread and all-rye bread.

NEUMANN, A. H. **Gh2**
1972
Ready-to-bake bread mix and process for its production
West German Patent Application 2 039 552 (In German)

Rye and wheat flours in proportion 3:2 are blended with leavening, salt and bread crumbs. The crumbs are steeped in salt solution, dried, and added to the flours to give a dry mix of good keeping quality.

WENZEL, H. **Gh3**
1971
Process for producing a special bread, similar to wholemeal bread, using rye, and an intermediate product
West German Patent Application 1 642 577 (In German)

A binding agent (such as de-husked cereal or rice flour, wheat-milling residues comprising flour and/or rye flour) is mixed with 1–5 times the quantity of rye-husk particles. A dough is formed with water and optional raising agents. Optimum ratio of rye-husk, binder and water is 1:1:2. The bread contains more husk than wholemeal bread.

WOLTER, K. **Gh4**
1973
Current problems of rye/wheat bread production from mixed rye/wheat flour
Getreide, Mehl und Brot, **27** (4), 141–147 (In German)

Bread was made from mixtures of 1 of 2 types of wheat flour with 1 of 2 types of rye flour. Wheat/rye ratios were graded between 0 and 100% and 6 methods of dough making were tried, in order to compare bread from flours mixed at the earliest stage of dough preparation with bread from flours mixed together at a later stage. Results are given. Blending at a later stage of dough preparation is recommended.

See also
A. 3
B. 6–8:27
D. 19
Ga. 1
Gk. 2
Ja. 37:64
Jm. 13:14
Jn. 1

KISS, A., VIDEKI, L. & FEBER, B. **Gj1**
1970
Quality problems of *Triticale*
Agrartudomany: Koslemenyek **29** (3), 281–290 (In Hungarian)

Six year cultivation trials with different varieties of *Triticale,* barley and maize are reported, and protein contents in the grain are given. The *Triticales* equalled the quality of rye flour and surpassed it in protein content. Mixed 50/50 with wheat flour, *Triticale* flour gave a tasty, porous bread similar in taste and colour to rye bread.

LORENZ, K., DILSAVER, W. & LOUGH, J. **Gj2**
1972
Evaluation of *Triticale* for the manufacture of noodles
J. Fd Sci. **37,** 764–767

Triticale flour was compared with durum, semolina and all-purpose flour for the manufacture of egg noodles and standard noodles. Results of cooking and tasting trials led to the conclusion that *Triticale* flour is suitable for noodle manufacture, and is, in some respects e.g. cooking time and cooking tolerance, preferable to the other flours.

SINGH, B., JUDD, C., HUGHES, J. L. & REDDY, S. G. **Gj3**
1973
A comparative study of protein, carbohydrates and mineral composition in flour and bread of wheat and *Triticale*
Cereal Sci. Today, **18** (9). (58th Ann. Meeting, American Ass. of Cereal Chemists) Abstract only.

Eight varieties of *Triticale* grown at Alabama A & M University were milled to make whole-grain flour and bread. The content of protein, starch, etc. was determined and compared with Blue Boy wheat. Protein content was invariably higher in *Triticale.* Whole *Triticale* bread was of very acceptable quality, and bread was also prepared from *Triticale* in combination with wheat, buttermilk, raisins and eggs. The amino acid composition of three *Triticale* varieties is discussed. (Shortened abstract)

TSEN, C. C., HOOVER, W. J. & FARRELL, E. P. **Gj4**
1973
Baking quality of *Triticale* flours
Cereal Chem. **50** (1), 16–26

Baking trials with *Triticale* flours indicated deficiency in quality and quantity of gluten, providing a weak dough structure, broken top and pale crust. Elimination of bulk fermentation and addition of improvers such as 0.5% sodium stearoyl lactylate enabled acceptable bread to be made from 13.6% protein *Triticale* flour, but low-protein (11.1%) *Triticale* flour required wheat flour supplements. The *Triticale* bread staled almost twice as rapidly as wheat bread.

Chenopods

Gk1

DE BRUIN, A.
1964
Investigation of the food value of quinoa and cañihua seed
J. Fd Sci. **29** (6)

A detailed study was made of the chemical composition of the seeds of three varieties of *Chenopodium quinoa* (red, yellow and white) and one variety of *Chenopodium pallidicaule*. Analyses included carbohydrate, proteins, minerals, vitamins and properties and constants of the oil. Values are given on a dry-weight basis. With respect to nutrient composition these seeds compare favourably with those of common cereals such as wheat, corn, oats and rice.

Gk2

FOOD AND AGRICULTURE ORGANISATION
Food crops of the altiplano of South America: quinoa
pp 14–18

Quinoa, cultivated on the high plains of South America, was a basic food in Inca times and continues to be a main constituent of the diet of the Indian peasant. There are three main varieties, of which the seeds are either red, yellow or white. The plants can withstand frosts and are drought resistant. Threshing is done by hand. The saponin content of the seed must be removed before eating by washing or toasting followed by light grinding. Reasonable bread can be made from wheat flour with up to 20% quinoa flour. Quinoa seeds contain no gluten but contain high percentages of protein and fat compared to wheat. The neutral taste after the saponin has been removed enables the grain to be used in a wide variety of foods.

Gk3

GANDARILLAS, G.
1973
Quinoa: the veritable treasure of the altiplano
Today (Newspaper), La Paz, Bolivia, August 28

Malnutrition and lack of protein in the diet of local peasants can be alleviated by the inclusion of quinoa in the diet. In some provinces the cereal is produced on a large scale. One kg of quinoa is equal in vitamin content and calories to one kg of meat. The fact that humans and animals can survive at all in some very cold high-altitude areas is due almost entirely to the abundance of quinoa. Land around the salt flats of Uyuni and Coipasa gives an annual yield of 240,000 tons from 120,000 hectares. In Peru, production and yield have been increased and some export to North American and European markets is showing dividends, while the technical problems involved in blending with wheat flour have been solved.

Gk4

QUIROS-PEREZ, F. & ELVEHJEM, C. A.
1957
Nutritive value of quinoa proteins
J. agric. Fd Chem. **5** (7)

Quinoa (*Chenopodium quinoa,* Willd.), an Incan seed used in human nutrition, supplies protein of high quality as judged by growth and lipotropic responses, in white weanling rats. Under experimental conditions at least seven essential amino acids had to be added to produce slightly better weight gains than those given by 90% quinoa alone. Combinations of quinoa and casein, giving the same

dietary protein as that supplied by quinoa alone, did not support better growth than quinoa, confirming the findings of other workers. However, the addition of 3% casein to quinoa, giving a total dietary protein of 12.42%, produced an excellent growth of 36.7 grams per rat per week and a normal liver fat.

See also
B. 26
E. 4

Teff

JANSEN, G. R., DIMAIO, L. R. & HAUSE, N. L. **Gm1**
1962
Amino acid composition and lysine supplementation of teff
J. agric. Fd Chem. **10** (1), 1

Six samples of teff and one of pearl millet were analysed for their essential amino acid content using ion exchange chromatography. The samples were fed to weanling rats for 4 weeks. Both cereals had a good amino acid balance, except for being markedly first limiting in lysine. Lysine supplementation of teff and millet was found to increase the PER of each to about that obtained with ANRC casein.

See also Jo. 18

Tubers and roots

General

SUBRAHMANYAN, V., MURTHY, H. B. N. & SWAMINATHAN, M. Ha1
1954
Effects of partial replacement of rice, wheat or ragi (*Eleusine coracana*) by tuber flours on the nutritive value of poor vegetarian diets
Br. J. Nutr. 8 (1), 1–10

Substitution of 25% of rice, wheat or ragi by tapioca or sweet potato flour in the diet of rats led to a distinct improvement in growth response, which was further increased by the inclusion of groundnut cake flour. Replacement of different percentages of rice by tapioca flour showed that even 50% substitution was not deleterious provided the diet was fed *ad lib.*

SUBRAHMANYAN, V. & SWAMINATHAN, M. Ha2
1959
Utilisation of tuber crops for meeting food shortage
Fd Sci. 8 (5), 177–181

Roots and tubers appear to be valuable sources of cereal substitutes and have the advantage of yielding 2–3 times as much calories per acre as cereals, and of being cultivable on a kitchen-garden scale. The study shows that blends of tuber flour and low-fat oilseed flour could be used as substitutes for cereals.

See also
B. 9
F. 34

Cassava

AYRES, J. C. **Hb 1**
1972
Manioc
Fd Technol. **26** (4), 128–132, 134, 136, 138.

The production, properties, economics and uses of manioc are discussed. There is a section on the use of manioc for breadmaking by blending with wheat or non-wheat flour.

FEDERAL INSTITUTE OF INDUSTRIAL RESEARCH, OSHODI, NIGERIA **Hb 2**
1970
Project 13.14 – Composite flour
Quart. Progress Rep. Jan–March, pp 13–18 and April–June, pp 13–18.

Wheat/cassava composite flour (70:30) was found suitable both for bread and for confectionery. Guinea corn flour, though richer in proteins, was less useful in composite flour. The results of bread and cake baking trials are tabulated, and some recipes given. A panel of 11 judges considered dilutions of 25% guinea corn and 40% cassava starch acceptable in flavour.

GOWRI SUR *et al* **Hb 3**
1954
Partial replacement of cereals by Mysore flour
Bull. Cent. Fd Technol. Res. Inst., Mysore, **3**, 85–87.

Nutrition trials were carried out on a group of girls aged 5–11 years to evaluate the replacement of 50% of the cereal in their diet by giving Mysore flour (75% tapioca flour and 25% groundnut flour) in the form of gruel. Weight, height, nutritional status, haemoglobin level and RBC count were recorded, and no significant differences were observed between experimental and control groups, except that the haemoglobin level rose significantly in the experimental group. It was concluded that 50% of cereals in poor vegetarian diets could be replaced by an equal quantity of Mysore flour.

HEIN, R. **Hb 4**
1970
Storage of bread flour containing cassava
Brot Gebäck, **24** (1), 20.

de MARTIIS, P. **Hb 5**
1969
The effect of additions of cassava starch, maize-flour and pre-cooked maize flour on the baking quality of commercial wheat flours
Revta Inst. Invest. technol., Bogotá, Colombia, **11** (58), 9–18. (In Spanish).

Baking tests were performed with 10 commercial wheat flours (5 domestic) blended with up to 10% cassava starch, maize flour or pre-cooked maize flour. Results are tabulated with analysis of variance. Loaf volume was reduced with all fortified domestic wheats, and it was concluded that all domestic wheats were unsuitable for supplementation with maize and cassava. Three of the supplemented imported wheats also gave reduced loaf volume but to a lesser degree.

MURTHY, H. B. N., *et al* **Hb 6**
1954
Effects of partial replacement of rice in a rice diet by tapioca on the metabolism of nitrogen, calcium and phosphorus in adult human beings
Br. J. Nutr. **8** (1), 11–16.

Six men were fed diets based on rice and on rice/tapioca (75:25). Intake and retention of nitrogen, calcium and phosphorus were studied; intake values were more satisfactory for the rice/tapioca diet except in the case of nitrogen; all the figures for average retention were higher for the rice/tapioca diet.

RASPER, V., HOI-MENG MAK & deMAN, J. M. **Hb 7**
Rheological behaviour of doughs from mixtures of wheat flour and modified cassava flours
Dept. of Food Science, University of Guelph, Ontario, Canada.

Rheological behaviour in tension of doughs from mixtures of HRS and modified cassava flours was studied, as was extensibility. The finest and purest fraction of partially fermented 'kokonte' failed to have a significant effect on rheological characteristics in concentrations below 30%, but a marked effect in higher percentages, as also did coarser fractions, changes being correlated to ash and fibre content. The effect of calcium-2-stearoyl lactylate was also studied.

ROTSCH, A. **Hb 8**
1969
The baking properties of cassava meal
Brot Gebäck, **23** (16), 121–122. In German.

SUBRAHMANYAN, V. & SWAMINATHAN, M. **Hb 9**
1958
Utilisation of tapioca flour and low-fat groundnut flour in meeting the food shortage
Fd Sci. **7** (10, 287–292.

Both in normal times and in periods of shortage, Mysore flour (a blend of tapioca and groundnut flours) can be used as a partial substitute for rice. A table shows the chemical composition of tapioca flour, groundnut flour, cereals and their blends.

SUBRAHMANYAN, V. *et al* **Hb 10**
1958
Utilisation of tapioca flour and low-fat groundnut flour admixed with wheat flour for the preparation of chapati and poori
Fd Sci. **7,** 4–6.

Chapati and poori were prepared from blends of whole wheat flour, tapioca flour and groundnut flour. The results indicated that satisfactory products could be made with tapioca and groundnut flours added to wheat flour at levels of 25–30%.

SUBRAHMANYAN, V. *et al.* **Hb 11**
1966
Processing of tuber flours with special reference to cassava (tapioca) into enriched macaroni type products
Int. Congress of Food Science and Technology, 1962, **4** 653–678.

The method of preparation and processing of a cassava/wheat semolina/groundnut flour (tapioca macaroni) is reported. There is a description of the processing plant, with illustrations and tables. Other new flour blends are also mentioned; these contain chickpea flour, casein and skim milk powder for protein enrichment.

See also

A. 4:8:11:16:22
B. 2:10–13:16:19:20:22–26:28:29:36:37
D. 13:14
F. 4:6:11:12:16:17:20:24–34:36–38
Ha. 1
Ja. 21:40
Jc. 2:5
Jg. 1:2
Jn. 4

Yams

See
A. 12
B. 11:13:17:21:25:36

Potato (*Solanum*)

Hd 1

ANON.
1973
Potatoes in bread doughs — editorial comment
British Baker, **167** (2), 14

A reply from the editor to a reader's enquiry, describing the method of incorporating potato in bread dough during wartime. Though in 1943 the Bread Regulations were amended to allow the use of potatoes and potato flour in the National Loaf, these are not permitted ingredients at present in the UK.

Hd 2

ANON.
1973
British Baker, Letters July 1973, p. 22.

A reader describes the method used by bakers in World War I to incorporate potatoes into bread dough.

See also
A. 14
B. 6:26
D. 13:19
Gb. 3:5:20
Gd. 6
Ja. 37
Jp. 2

Sweet potato, aroids, etc.

GORE, H. C. **He 1**
1923
The value of sweet potato flour in breadmaking
Ind. Engng. Chem. ind. Edn. **15** (12), 1238.

Sweet potato flour, produced from washed, sliced and dried tubers, can be added to wheat flour to increase the loaf volume of wheat-based bread. The optimum percentage addition for this purpose was found to be 1.5%.

HAMED, M. G. E., HUSSEIN, M. F., REFAI, F. Y. & EL-SAMAHY, S. K. **He 2**
1973
Preparation and chemical composition of sweet potato flour
Cereal Chem. **50** (2), 133–139.

Preparation of a sweet potato flour suitable for use as an extender for wheat flour in bread was studied. Peeled and unpeeled tubers were equivalent in yield and colour, but the latter were higher in fibre and ash content. Soaking of slices in 0.5% sodium metabisulphite for 2 mins. was judged preferable to treatment with sodium chloride or citric acid in preventing discoloration during processing. Studies were made of protein, carbohydrate, sugar, etc., contents as compared with wheat flour. Qualitative paper chromatography was used to determine the amino acids present in hydrolysed sweet potato protein.

HAMED, M. G. E., REFAI, F. Y., HUSSEIN, M. F. & EL-SAMAHY, S. K. **He 3**
1973
Effect of adding sweet potato flour to wheat flour on physical dough properties and baking
Cereal Chem. **50** (2), 140–146.

Studies were made of the effects of adding sulphite-treated, untreated and sulphite-and-ascorbic-acid-treated sweet potato flours to wheat flour in baking of bread. Additions ranging from 10–30% of all the sweet potato flours had a deleterious effect on the physical properties of dough, particularly with additions of SO_2-treated flour, the effect in this case being alleviated by the admixture of 0.1% ascorbic acid. An increase in weight and decrease in the volume of the bread was noted. The quality of the bread was impaired less with the addition of SO_2-treated flour, with or without ascorbic acid, than with non-SO_2-treated flour. Addition of 10% SO_2-treated sweet potato flour in Balady bread increased both acceptability and yield.

LUNA DE LA FUENTE, R. **He 4**
1960
Experiments in breadmaking from flour mixtures of wheat and three varieties of sweet potato
Bolivian trim. Exp. agropec., **9** (3), 10–13.

Peeled, sliced dried and milled tubers were added to wheat flour at 5, 10, 15 and 20% levels. A level of 10% gave bread of good quality, but higher levels are not recommended.

PLAUT, M. & ZELZBUCK, B. **He 5**
1958
Use of sweet potatoes for flour and bread
Kvatim, **8** (1–2), 77–91.

The addition of sweet potato by-products to the dough of standard bread has a negative influence on bread quality. Bread volume decreases, the crust fails to brown, the crumb becomes grey and the dough becomes brittle. These negative characteristics become more pronounced as the percentage of sweet potato by-products is increased.

SAMMY, G. M. **He 6**
1970
Studies in composite flour; the use of sweet potato flour in bread and pastry making
Trop. Agric., Trin., **47** (2), 115–125.

Sweet potato flour may be used without difficulty with wheat flour at a rate not exceeding 15% in bread and at 20 or 30% in pastries. Baking properties were similar for peeled and unpeeled tubers. 1% glyceryl monostearate and 1% glyceryl monopalmitate improved the baking properties only slightly, and a high protein additive also had little effect on baking. Sodium metabisulphite improved flour colour but more than 100 ppm SO_2 affected baking properties.

SINGH, R., RAFIQUE, M. & BAINS, G. S. **He 7**
1953
Investigations on the preparation and use of sweet potato and groundnut cake flours in conjunction with wheat for leavened bread (Dabal Roti) and chapaties
Indian J. agric. Sci. **23** (2), 139–146.

The optimum level of sweet potato (peeled, boiled, dried and ground) in wheat atta for chapaties was found to be 30%, while in the baking of leavened bread the limit was 5%. The use of unscalded dried sweet potato caused darkening of the flour blend owing to oxidation of the slices during drying. Groundnut cake flour caused clogging of the sieve during sifting, which was overcome by adding a few maize grains. Both for chapaties and leavened bread the appropriate level of addition was found to be 5% in the case of groundnut cake flour.

WARE, L. M., HARRIS, H. & VAN DE MARK, M. S. **He 8**
1947
Baking with sweet potato flour
Fd Ind. **19,** 101, 200, 202. (pp 1365, 1464, 1466).

A sweet potato flour, named 'Alamalt', was developed at Alabama Agricultural Experiment Station and tested in a number of foods, replacing a portion of the eggs, butter and sugar in cakes and pies, with good results. The flour was prepared by baking the sweet potato, followed by peeling, pulping, extruding, drying, toasting and milling.

See also
A. 4:14
B. 26
Ha. 1
Jc. 2

Protein supplementation

General

ADRIAN, J. & FRANGNE, R. **Ja 1**
1969
Nutritional value of biscuits enriched with pure lysine, or various protein complements: groundnut, fish or milk

Inds. aliment. agric. **86** (6), 801–806. (In French).

Biscuits were processed from wheat flour mixed with pure lysine, groundnut flour, fish flour and dried skim milk. The baking process caused a drop in PER, in the groundnut by 30%, in the fish by 40%; there was a loss of lysine and methionine; the PER in the case of milk dropped to nil. It was concluded that detrimental substances were formed in the Maillard reaction.

ALI, S. M. **Ja 2**
1972
Development of low-cost protein supplements from non-conventional protein sources in Pakistan

Science and Industry, Pakistan, **8** (2), 107–125.

The need for an increased supply of protein in Pakistan, and the problems connected with the production of flour from oilseeds, are discussed. Studies are in progress into the adaptation of less conventional protein sources, such as FPC flour from shark, and flour from guar, rape, mustard, coconut, groundnut and sesame. Leaf proteins and single cell proteins are also mentioned. Comparative tables are included.

ALTSCHUL, A. M. & ROSENFIELD, D. **Ja 3**
1972
Protein supplementation: satisfying man's food needs

Fd Technol. Aust. **24** (6), 269–281.

Survey of protein in a variety of foodstuffs, with tables illustrating the fortification of staple foods, new protein sources, etc. There are sections on cereals, protein mixtures for infant feeding, and fortified major foods.

ANON. **Ja 4**
1970
Filipinos try new bread

Foreign Agriculture, May, 1970, p 11.

Short news item relating to lysine-fortified bread, 'Vita-L-Lysine', produced on a limited scale by a Philippine flour mill.

Ja 5

ANON.
1970
New bread for Brazil has been developed by the Tropical Centre for Food Research and Technology
Fd Engng. **42** (9)

New bread developed at Campinas has the formula 78% wheat, 20% pregelatinised flour, 1% dry skim milk and 1% soya bean flour. Nutritious, tasty and cheap, it could save Brazil millions of dollars in wheat and flour imports.

Ja 6

ANON.
1972
Manufacture of bakery foods possessing high biological value
Zagadnienia Piekarstwa ZBPP **17** (1), 62–63. (In Polish).

Report on the fortification with milk, fish protein and pulses of bakery products. Over 100 kinds of baked goods are enriched with 20–30% soya flour, 20% pea flour or 0.15–0.5% lysine.

Ja 7

AYLWARD, F.
1971
Nutritional aspects
Symposium on the use of non-wheat flour in bread and baked goods manufacture. Tropical Products Institute Report G62, 33 pp.

The author stresses the necessity to provide protein foods but not at the expense of ignoring high energy foods. He reviews the distribution, over the world, of protein and energy sources, and points out that even foods low in protein may be valuable where that food is eaten in large quantities. Milk supplementation of bread is mentioned. In a cereal programme in low-income countries, the consumption of bread should be encouraged not only for itself but as a vehicle to encourage the use of other foods, such as cheese. Quality control of raw materials is important when organising a cereal programme in developing countries.

Ja 8

BAINS, G. S.
1970
Baked products of improved protein status
Proc. seminar on scientific utilisation of wheats, New Delhi, India, pp 39–42.

Ja 9

BALLESTER, D., BARJA, I., YANEZ, E. & DONOSO, G.
1968
Protein-rich mixtures for human consumption based on fish flour, sunflower press cake meal, dried skim milk and wheat flour
Br. J. Nutr., **22** (2), 255–259.

Five high-protein mixes made up of various proportions of fish-flour, bread, wheat flour, roasted whole wheat flour, durum flour, skim milk and sunflower press cake were investigated. Net protein utilisation compared favourably with that of Incaparina and exceeded that of Peruvitas, and the protein values of the mixes were higher than the values recommended in the diet of infants.

Ja 10

BREESE-JONES, D. B. & DIVINE, J. P.
1944
The protein nutritional value of soya bean, peanut and cottonseed flours and their value as supplements to wheat flour
J. Nutr. **28,** 41–49.

The protein value of soya bean, peanut and cotton seed flowers were assessed alone and as supplements in wheat flour by studying growth rate in rats. The

flours were found to be of high nutritive value and could partially replace animal protein. As supplements, the addition of 5 parts of 95 parts of wheat flour gave a mix with protein content up by 16–19% over wheat and formed a growth-promoting protein combination superior to wheat protein alone.

BRESSANI, R. & ZAGHI, S. DE **Ja 11**
1970
Suplementación de caséina y de mezelas vegetales a base de harina de soya, con metionina, hidroxi analogo de metionina y vitamina B
Arch. Lat. Nutr. Venezuela, **20** (2), 179–194.

BRIONES, P. R. *et al* **Ja 12**
1970
Coco-crunchies: a high-protein snack food
Philippine J. Nutr. **23** (1), 14–20.

High-protein crunchies (347 cal. and 28.6% protein/100g) were prepared from a batter made by mixing coconut flour, shrimp flour and wheat flour. Stored samples were acceptable after six months.

BRUINS, H. W. & MONEY, H. W. **Ja 13**
1967
Production and marketing of high protein foods in Latin America
Cereal Sci. Today **12** (10), 418–420, 437.

In Latin America nutrition is tied in with the economic situation in each country. The development of the Incaparina formula is described. The report deals with availability of local ingredients, processing techniques, product usage, merchandising and distribution.

BUCHANAN, A. M. **Ja 14**
1971
The Cambridge formula loaf
Symposium on the use of non-wheat flours in bread and baked goods manufacture, Tropical Products Institute Report G62. Also, *British Patent* No. 1060071.

The development of a product similar to bread, low in carbohydrate and high in protein, is discussed. Chemical analyses are given. Protein sources are wheat, wheat-germ, and enzyme-inactivated full-fat soya flour, all being obtained from natural sources with no supplementary enrichment.

DARWISH, N. & EL-NOCKRASHY, A. S. **Ja 15**
1971
Enrichment of wheat flour with lupin flour
Getreide, Mehl und Brot **21** (10), 96–98; (11) 102–107. (In German)

Up to 20% lupin flour was used with wheat flour for breadmaking and increased the protein content, e.g. 15.75% protein at the 20% level. Lupin flour, bread from lupin and wheat flours and wheat bread were each analysed for moisture, ash, fat, crude fibre, protein and available lysine content. Additions of up to 15% lupin flour caused no significant differences in bread quality, but bread containing 20% lupin flour was inferior. Nutritional value was found to increase linearly with increasing increments of lupin flour.

DESHPANDE, P. D., HARPER, A. E. & ELVEHJEM, C. A. **Ja 16**
1957
Nutritional improvement of wheat flour with protein and amino acid supplements
J. Nutr. **62**, 503–512.

The growth rate in young rats was increased from 3 to 21 gm/week when their diet, containing 78% of white flour, was supplemented with 0.5% L-lysine and 0.4% DL-threonine. Further improvement occurred only when 7 more essential amino acids were included. Although lysine was limiting for growth, liver fat did not accumulate when the diet contained 78% of white flour. However, fatty infiltration which occurred when the flour was fed at a 5.4% protein level, was prevented by a lysine supplement. Maximum growth was obtained when intact protein formed part of the supplements, but was not so rapid when the protein was replaced by equivalent amounts of crystalline amino acids.

DREYER, J. J. **Ja 17**
1968
Supplementary effect of the NNRI food mixture on cereal proteins
S. Afr. med. J. **42**, 604–610.

The paper gives the results of protein value (digestibility and biological value) estimates on certain combinations of foods, including maize, groundnut, FPC, de-fatted soya meal, skim milk powder, bread and rice. It was concluded that 1 ounce quantities of FPC, soya, skim milk powder and two of the food formulae developed by the NNRI (National Nutrition Research Institute) will all meet the protein allowances for children of 9 months to 9 years when consumed with a quantity of maize meal sufficient to yield a calorie intake of 80% of the daily requirement.

EHLE, S. R. & JANSEN, G. R. **Ja 18**
1965
Studies on breads supplemented with soya and non-fat dry milk and lysine. I Physical and organoleptic properties
Fd Technol. **19** (9), 129–133.

Various combinations of soya flours, non-fat dry milk (NDM) gluten and lysine monohydrochloride (LMH) were evaluated when added to bread. Soya supplementation corresponding to 6% NDM had little effect. Soya supplementation corresponding to 25% NDM was harmful. LMH increased crust coloration. Addition of wheat gluten with soya supplement on an isonitrogenous basis prevented deficiencies of the high protein breads.

EHLE, S. R. & JANSEN, G. R. **Ja 19**
1965
Studies of breads supplemented with soya and non fat dry milk and lysine. II Nutritive value
Fd Technol. **19** (9), 133–136.

Experimental breads containing various combinations of soya supplements, non-fat dry milk (NDM), wheat gluten and lysine were evaluated in growing rats for protein nutritive value. Except for NDM breads the PER was proportional to lysine content up to 4.7 and 5.3 g lysine/16 g nitrogen, when 85% and 60% respectively of protein was supplied by wheat. Wheat gluten, white flour, whole wheat and 4% NDM white bread were all found to be second-limiting in threonine.

FELLERS, D. A. & BEAN, M. M. **Ja 20**
1970
Flour blend A: I Origin and history II Storage studies
Baker's Dig. **44** (6), 40–45, 48, 49.

Flour Blend A was developed by the United States Department of Agriculture to reduce malnutrition in developing countries and consists of 70% wheat flour and 30% wheat protein concentrate. Blend A was subjected to storage tests under adverse conditions. Stability was increased when the moisture content was reduced from 13% to 9%.

FOOD AND AGRICULTURE ORGANISATION **Ja 21**
1970
Nutritional aspects of composite flours
FAO/Industry Cooperative Programme, Food Industries and Marketing Sub-group, AGS:G/70/11. See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised, 1973)

Bread was prepared from blends of cassava and soya flours and cassava and groundnut flours. Net protein utilisation, digestibility (% N not excreted) and protein efficiency ratio were determined and compared with common Dutch wheat bread, with favourable results.

FORMAN, M. J., CROWLEY, P. R. & WEISBERG, S. M. **Ja 22**
1972
Improved bread products for overseas: What are the next steps?
Cereal Sci. Today, **17** (9) (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Effective technology for formulating bread from protein-rich materials has outstripped the practical application of these techniques. Proposals are made for implementing this technology and thus promoting the use of these bread products among undernourished peoples.
(Shortened abstract).

GRAHAM, R. P., MORGAN, A. I., HART, M. R. & PENCE, J. W. **Ja 23**
1968
Mechanics of fortifying cereal grains and products
Cereal Sci. Today **13** (6), 224.

The authors describe various methods of enriching wheats with protein or lysine. These include coating, either with dry high-protein flour or proteins in suspension; infusion with soluble protein or lysine; mixing with synthetic grain, drum-drying to form re-hydrateable mixes; and coating with dry flours followed by cooking and flaking.

HEATH, D. J. & HAWLEY, H. B. **Ja 24**
1964
Proteinaceous materials, farinaceous compositions incorporating them, and baked products thereof
UK Patent Specification, No. 1,074,087.

A process of bread enrichment, where the additional proteinaceous material consists partly of protein isolates, concentrates and/or denatured protein and partly of alkali metal and/or alkali earth metal proteinates.

HEPBURN. F. N. **Ja 25**
1973
The nutritional fortification of wheat foods

Cereal Sci. Today, 18 (9). (58th Ann. Meeting, American Ass. of Cereal Chemists) Abstract only.

The present status of wheat-food fortification with vitamins, minerals and protein is presented in relation to historical development and projected trends for the future. The value of certain trends is questioned and alternative courses are examined. The limitations imposed by technological problems, the impact of nutrition labelling regulations and the difficulty in meeting nutritional needs of the population are discussed.

HOOVER, W. J. **Ja 26**
1970
Research on high-protein breads

Rep. FAO/Industry Cooperative Programme on Food Industries and Marketing Subgroup, AGS:MISC/70/12. See also *FAO Composite flour programme, Documentation package,* Vol. 1 (revised, 1973).

A review of research in the USA and elsewhere into the use of non-wheat flours as extenders in wheat bread. It is concluded that, with one or two exceptions, non-wheat flours or protein products of consistent quality are not yet available in sufficient quantity to permit wide usage.

HORAN, F. E. **Ja 27**
1973
Nutritional cereal blends — conception to consumption

Cereal Sci. Today, 18 (9). (58th Ann. Meeting, American Ass. Cereal Chemists). Abstract only.

A review of the field experiences with wheat-soya-blend and other 'engineered' high-protein cereal-based foods, with recommendations as to how the cereal chemist and food technologist can be of greater assistance in the solution of world food problems.

HOWARD, H. W. & MONSON, W. J. **Ja 28**
1958
The nutritive value of bread flour proteins as affected by practical supplementation with lactalbumin, non-fat dry milk solids, soybean proteins, wheat gluten and lysine

J. Nutr. **64**, 151–165.

The nutritional effects of supplementing wheat flour with lactalbumin, NFDM, soya bean protein, wheat gluten and lysine were examined. The results confirmed the assumption made by the authors that a well-balanced or 'complete' protein contains 5.3g lysine per 16 g N. Equal lysine intakes and equal growth rates were found in isonitrogenous diets where high or low protein wheat flours were the only source of protein.

HUSSEY, J. C.
1969 **Ja 29**
Incaparina in Colombia

USDA Publication, ARS 72–71. *(Proc. Conf. on Protein-rich Food Products from Oilseeds, New Orleans, May, 1968)*

The Incaparina formulation developed for Colombia by INCAP in 1963 contains corn flour, soya flour, cotton seed flour, calcium carbonate and vitamins; local ingredients accounting for 98% of the total. The report discusses the reasons for

good acceptance of the product in Colombia, and mentions the current thinking on possible improvements to the product, including replacement of the corn flour with sorghum grain.

HUTCHINSON, J. B., MORAN, T. & PACE, J. **Ja30**
1959
The nutritive value of bread protein as influenced by the level of protein intake, the level of supplementation with L-lysine and L-threonine, and the addition of milk and egg proteins
Br. J. Nutr. **13** (2), 151–163

The content of amino acids in flours of low protein and high protein content (26.8% by air-classification of the low protein flour) was determined by chromatography. The growth rate of weanling rats fed on diets containing bread made from these flours, with and without amino acid fortification, was examined, and the growth rates obtained with lysine and threonine were compared with those observed for casein, skim milk powder, whole-egg protein and mixtures of these with bread. The results are discussed in relation to the intakes of essential amino acids.

IWAN, J. L. **Ja31**
1968
Fortified bread takes hold in India
Cereal Sci. Today **13** (5)

Review of work under the Colombo Plan to introduce to the Indian diet bread fortified with vitamins, minerals and lysine, under the name of 'Modern Bread'.

JANSEN, G. R., HITCHISON, C. F. & ZANETTI, M. E. **Ja32**
1966
Supplementation of bread with fish flour and amino acids – a comparison of evaluation methods
Fd Technol. **20** (3), 91–94

In evaluating various methods of protein quality estimation, it was concluded that PER estimation is a valid and sensitive method, that the NPR-PRE method (net protein ratio – protein retention efficiency) is better than PER alone, and that carcass-N analysis is not essential. Addition of lysine and threonine doubled the utilisability of bread protein. A 6% addition of fish flour gave a PRE of 58, which was raised to 72 by the addition of 0.2% lysine. 0.4% L-lysine and 0.15% L-threonine without fish flour gave a PRE of 77 compared to 88 for ANRC casein.

Ja33

JANSEN, G. R.
1969
Total protein value of protein- and amino acid- supplemented bread
Am. J. clin. Nutr. **22** (1), 38–43

A net protein value (NPV) was determined (quality X quantity) for breads supplemented in various ways. It was found that supplementation with proteins and lysine in combination enabled the protein to give better response to lysine, while the lysine enabled lower levels of protein supplement to be used.

JANSEN, G. R. **Ja34**
1971
Role of seeds as a source of protein for humans
Abstr. of Papers, American Chem Soc. 161: AGFD 41

The protein quality, quantity and net protein value of diets consisting of various cereals in combination with pulses, oilseed protein concentrates and animal protein are discussed, and the implications of these data for the fortification of cereals are considered.

JOHNSON, P. E. **Ja35**
1973
High-protein blended foods in the Food for Peace Program
Cereal Sci. Today **18**, 138–141

High-protein and fortified foods are particularly important in meeting the protein requirements of acutely malnourished and other specific population groups, such as infants. In the 'Food for Peace Program', shipments of such foods have reached 85 million people and opened their eyes to the possibilities regarding better nutrition. Soya-fortified corn meal, bulgur and rolled oats are now available under the programme, and Blend K (soya-fortified wheat flour) is expected to follow.

JOHNSON, P. E. **Ja36**
1973
Bread: Now a better food
Soybean Dig. **34** (1)

Report on the fortification of bread with soya protein under the 'USAID Food for Peace Program'. The first shipments were made to India and the Philippines for testing in child-feeding programmes; by May 1973 more than 36 million lbs had been produced for shipment abroad to the Far East and South America. The fortified bread is the most recent of the high-protein products developed under the programme, others being CSM (corn, soya, dried milk) and WSB (wheat-soya blend).

KAUTZ, K. **Ja37**
1971
Process for producing a protein-enriched baked or powder form food product and product produced by this process
West German Patent Application 1945–543. (In German)

Wheat, rye, maize, potato or coconut, in the form of groats, bran or flour, are dried or roasted and a high-protein product (e.g. milk products, fish protein, gluten) is added at a rate of 15–80% by weight. Flavourings or fruit may be added. The protein remains unaffected as the product is not heated after mixing.

KRISHNAMURTHY, K. *et al* **Ja38**
1960
Studies on the nutritive value of composite protein foods based on blends of groundnut, soya bean and sesame flours
Fd Sci. **9** (3), 86–88

PER and overall nutritive values were determined for composite protein foods containing low-fat groundnut flour, processed soya flour and low-fat sesame flour with addition of calcium phosphate and vitamins, and compared with skim milk powder. PER was found to be higher than that of a blend of groundnut and gram flours (*Fd Sci.* **9** (3)). Diets containing 16% protein from the blends under study were found to be as effective as diets containing skim milk powder in promoting growth in rats.

LACHMANN, A. **Ja39**
1971
Factors in developing high protein foods
Fd Engng. **43** (5)

Nutritional requirements, technology, and local diet are factors to be acknowledged in the development of high protein foods. High protein biscuits, now being marketed in Australia and India, are described.

LEAGUE FOR INTERNATIONAL FOOD EDUCATION **Ja40**
1973
Improving nutrition in Brazil
Newsletter Sept. 1973

The report concerns two efforts by USAID to improve nutrition in Brazil, one of these in respect of the supplementation of cassava flour, a major food staple in Brazil, with soya protein isolate. Attempts to add synthetic methionine (low in the soya protein) proved unsuccessful as odour and flavour were poor. Soya grits containing 50% protein were tried at the 10% level, and consumer acceptance tests are being made.

LOCKMILLER, N. R. **Ja41**
1973
Increased utilisation of protein in foods
Cereal Sci. Today **18** (3), 77–81

Report on the use of protein in foods, including bread and baked goods, and in high-protein formulations for feeding programmes. The preparation and use of isolates and concentrates from soya are described.

LORENZ, K. & MAGA, J. **Ja42**
1972
The production of high protein bread under reduced atmospheric pressures
Cereal Chem. **49**, 522–531

Flours fortified with de-fatted soya, cotton seed, groundnut and FPC can be processed under reduced atmospheric pressures, eliminating chemical additives. Breads supplemented with 15% of the above protein additives and processed at 525 mm Hg were at least equal in volume to controls treated at 765 mm; texture, flavour, etc. improved with decreasing pressure, with partial loss of many off-flavours associated with the supplements. Fermentation and proofing times decreased with decreasing atmospheric pressures.

LYNN, C. S. **Ja43**
1970
Protein-fortified products
USA Patent No. 3 697 290

Leavened baked goods contain a non-elastic protein (e.g. sesame, or sesame and soya bean) and an elastic vegetable protein (e.g. wheat gluten or gluten and vegetable gums), flavouring, and texturing agents.

MILNER, M. (EDITOR) **Ja44**
1969
Protein-enriched cereal foods for world needs
American Association of Cereal Chemists, 343 pp

The publication discusses, among other things, the role cereals will play in meeting the protein requirements of the world, their nutritional value and possibilities,

recent developments in improving cereal protein by genetic means, and the use of newly developed protein concentrates in the formulation of cereal foods, including bread.

MILNER, M. **Ja45**
1970
Glycolipids and protein supplementation of bread
PAG Bull. **9**, 7

The generalisation that wheat flour, because of its gluten content, is essential for making a good loaf of bread is no longer true. With the use of certain sugar-lipid-type emulsifiers, satisfactory bread with acceptable loaf and crumb characteristics can be produced from non-wheat flours.

MOTTERN, H. H., de BUCKLE, T. S. & PARDO, C. **Ja46**
1970
Protein enrichment of Colombian corn cakes
Cereal Sci. Today **15** (4)

A formula was developed for enriched corn cakes (arepas) using 88.7% Opaque-2 corn meal, 5% soya flour, 5% corn gluten and salt. The product is intended to compete in the market place with conventional arepas, and consumer acceptance studies may dictate modifications in the formula, but there is need for an economical protein-enriched diet if further malnutrition is to be avoided.

NIWANO, S. **Ja47**
1971
Protein-enriched bread
Japanese Patent No. 29 179/71. (In Japanese)

Enrichment of bread and biscuit doughs is accomplished by addition of a coagulate obtained from a protein suspension.

NORTON YOUNG, L. **Ja48**
1970
Factors for consideration in the development of foods having a high protein value
Revta Inst. Invest. technol., Bogotá, Colombia **12** (64), 8–19; (65), 7–12

Land resources, principal crops, population, etc. are factors which affect the supply of adequate foods for South America. Cost evaluation of foods can be based on an 'intrinsic value' factor (IV), which takes into account cost of calories and cost of protein and allows relative costs to be indicated for a variety of foods (commercial cost X 100/IV). IV and comparative costs of 18 foods in 3 Colombian cities are tabulated, best results being shown by enriched 'pasta' (75% of wheat replaced by other cereals or soya flour).

ORR, ELIZABETH
1972 **Ja49**
The use of protein-rich foods for the relief of malnutrition in developing countries: an analysis of experience
Tropical Products Institute Report G73, 71 pp

Protein-rich food schemes are described and evaluated. Tables show the cost, biological value, composition, etc. of protein-rich foods. Retail prices, plant capacity and outlets are also tabulated.

PARMAN, G. K. **Ja50**
1968
Fortification of cereals and cereal products with proteins and amino acids
J. agric. Fd Chem. **16** (2), 168–171

Fortification of staple cereals with protein concentrates or pure amino acids as an aid to alleviating malnutrition, choice and source of these, method of fortification and economic factors involved are discussed.

PATT, V. A. & STOLJAROWA, L. F. **Ja51**
1970
Raising the biological value of bread
Bäcker u. Konditor **18** (5), 132–133

The authors discuss the protein supplementation of bread, and consider the value of adding milk products, soya flour, lysine, pea meal and fish meal. They discuss a method of adding 10–20% dried milk to flour without adverse effect on bread.

PATT, V. A. *et al* **Ja52**
1971
Comparative evaluation of new types of bread possessing higher biological value
Khlebopekarnaya i Konditerskaya Promyshlennost', **15** (11), 6–9. (In Russian)

Breads enriched with a) 10% dried skim milk, b) 25% soya bean flour, c) 25% pea flour or d) 0.5% lysine were compared with wheat bread in respect of acidity, rising time, etc. Protein digestibility was also assessed, and the results were as follows: control, 87.0 – 94.07%; a) 89.28 – 94.30%; b) 87.8 – 94.00%; c) 86.5 – 93.2%; d) 90.1 – 96.5%.

POMERANZ, Y., SHOGREN, M. D. & FINNEY, K. F. **Ja53**
1969
Improved bread making properties with glycolipids: I. Improving soy products with sucroesters
Cereal Chem. **46** (5), 503–511

Addition of 0.5% sucroglycerides to flour had no significant effects on dough preparation (apart from increasing water absorption and hot-paste viscosity); counteracted the deleterious effects of up to 16% soya products on loaf volume and improved crumb grain and softness.

POMERANZ, Y., SHOGREN, M. D. & FINNEY, K. F. **Ja54**
1969
Improved breadmaking properties with glycolipids: II Improving various protein enriched products
Cereal Chem. **46** (5), 512–518

Loaf volume and crumb in protein enriched bread could be improved by addition of shortening, and more so by adding sucrose tallowate, but at high levels the latter increased mixing time and impaired rheological properties. Improvement in bread volume and crumb as a result of adding 0.5 – 1.0% glycolipids equalled the use of 3% shortening.

POMERANZ, Y. **Ja55**
1969
High-protein supplements in bread making
Bakers' Dig. **43** (5), 39–40, 65

A brief review, with emphasis on soya flour as the enriching ingredient and glycolipids as crumb improvers.

POMERANZ, Y. **Ja56**
1970
Protein enriched bread
CRC Crit. Rev. Fd Technol. **1** (3), 453–478

A review of recent developments in production of protein enriched bread.

POMERANZ, Y. & FINNEY, K. F. **Ja57**
1972
Protein-enriched baked products and method of making same
USA Patent No. 3,679,433, July, 1972

Nutritionally improved baked products of consumer-acceptance quality are produced by adding small amounts of naturally-occurring or synthetic glycolipids to dough formulations containing added protein concentrates from plant or animal sources.

POMERANZ, Y. & FINNEY, K. F. **Ja58**
1973
Protein-enriched bread
Process Biochem. May 1973

By adding high levels of protein supplements plus glycolipids it is possible to maintain consumer acceptance of enriched bread with protein content increased by about 70% and concentration of lysine content almost tripled.

POMERANZ, Y. & FINNEY, K. F. **Ja59**
1973
Glycolipids: Key to protein-enriched bread
Fd Engng. May 1973, 134–142. (See also *USA Patent* No. 3,679,433)

Normal and synthetic glycolipids are said to assist gas-retention by forming hydrophilic bonds with gliadin proteins and hydrophobic bonds with glutenins, and can modify the hydration of non-cereal proteins, rendering them compatible with gluten. The adverse effects of non-cereal proteins on loaf volume and structure may be counteracted by adding glycolipids.

SCRIMSHAW, N. S. *et al* **Ja60**
1958
Supplementation of cereal proteins with amino acids. I Effect of amino acid supplementation of corn-masa at high levels of protein intake on the nitrogen retention of young children
J. Nutr. **66**, 485–499

SENTI, F. R., COPLEY, M. J. & PENCO, J. W. **Ja61**
1967
Protein fortified grain products for world uses
Cereal Sci. Today **12** (10), 426–430, 441

Maintaining that cereal grains, legumes and oilseeds will play an increasingly important part in human nutrition all over the world, the authors review a variety of grain products made in the USA for shipment abroad. In all cases the processing is simple enough to be adapted to local conditions of manufacture. Wide diversities of need, local preference, tradition, etc. pose a formidable challenge, and are often more limiting than the properties of the product.

SHAW, R. L. Ja62
1972
Incaparina: The market development of a protein food
Trop. Sci. **14** (4), 347–371

The market development of Incaparina, a low-cost protein food, is discussed in relation to Government participation, marketing efforts by food companies, etc. Special attention is paid to the commercial distribution of the product in a relatively small market, such as Panama.

SOMOGYI, J. C. Ja63
1970
Some problems of the improvement of the nutritive value of foods
Excerpta Medica Int. Congress Series, 1969 (213), 773–777. 8th Int. Congress Nutr., Prague, 1969

The improvement in the nutritive value of foods is discussed with special reference to bread, cereals (particularly rice and noodles), milk and dairy products, fats, fruit juices and confectionery.

STAHL, F. Ja64
1970
Complementary improvement in biological value of cereal proteins
Vitalstoffe-Zivilisationskrankheiten **15** (4), 134–139. (In German)

The mixing of the proteins of cereals (wheat, rye, oats, rice, maize and buckwheat) with other proteins leads to an increase in the biological value. Diagrams show the effect of each of the cereal proteins on about 40 other proteins. The number of these protein mixtures with a biological value of over 45 is given.

STERNER, M. M. Ja65
1972
Increasing the supply and acceptance of low-cost protein foods in developing countries
Cereal Sci. Today **17** (9). (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Despite international aid, per capita protein intake is falling further behind in some developing countries. This situation and its causes are analysed. Current efforts to improve distribution, and opportunities for the food industry in the light of the shift towards on-the-spot aid, are discussed.
(Shortened abstract)

SUBRAHMANYAN, V. *et al* Ja66
1959
Supplementary value of a protein food based on a blend of coconut meal, groundnut flour and bengal gram flour to the diet of children
Ann. Biochem. exp. Med. **XIX** (6). *Fd Sci.* **8** (3), 84–86

Nutrition trials using paired boys aged 7–12 were carried out over a period of 8 months to assess the value of supplementing their diet with a multi purpose food composed of groundnut flour, coconut meal and gram flour fortified with vitamins and minerals. Increase in height, weight, red cell count and haemoglobin levels were significantly higher in the experimental group. 14 of the 20 boys receiving the supplement showed improvement in nutritional status, whereas 3 boys in the control group showed deterioration and none showed improvement.

Ja67

TASKER, P. K. *et al*
1960
Supplementary value of composite protein foods containing a blend of coconut meal, groundnut flour and bengal gram to poor rice diet
Fd Sci. **9** (3), 84–86

Rat-growth assay was used to determine the supplementary value of various mixes of low-fat groundnut flour, coconut meal and gram flour, with addition of calcium phosphate and vitamins. It was concluded that the blends would constitute a valuable supplement to poor diets where coconut meal is available in large amounts.

Ja68

TSEN, C. C.
1971
Research on composite flours at Kansas State University
Dept. of Grain Science and Industry, Kansas State University, Manhattan, Kansas. *Symposium on Composite Flours, Vienna, 1971.* (Study Group 32: ICC)

1) Preparation of high-protein breads.
2) Shortening-sparing effect of sodium stearoyl-2-lactylate and calcium stearoyl-2-lactylate in breadmaking.
3) K-State process for making high-protein breads.
4) Nutritional feeding studies with high-protein bread.

Ja69

TSEN, C. C., HOOVER, W. J. & PHILLIPS, D.
1971
High protein breads: Use of sodium stearoyl-2-lactylate and calcium stearoyl-2-lactylate in their production
Bakers' Dig. **45** (2), 20–23. See also *PAG Bull.* 1972, **2** (3), 42–49

Wheat flour supplemented with up to 16% of soya flour or with other protein-rich foods was studied when treated with SSL or CSL. SSL was more effective than CSL but both improved flour performance.

Ja70

WEISBERG, S. M.
1972
Developing and marketing low-cost protein foods in developing countries
Fd Technol. **26** (9), 60, 62, 64, 66, 68

The case-histories of some low-cost high-protein foods in the developing countries are outlined. The products mentioned include Incaparina, Modern Bread, macaroni and noodles.

See also
B. 35:36
D. 5:22
F. 5
Gc.15

Soya

ADLER, L. & POMERANZ, Y. **Jb1**
1959
Use of lecithin in production of bread containing de-fatted soya flour as a protein supplement
J. Sci. Fd Agric. **10**, August 1959

Bread was baked using flour extracted from different plant materials and wheat of varying strengths which were mixed with de-fatted soya flour and prepared without addition of sugar and fat. It was found that, by increasing the level of oxidising agent to the optimum and adding lecithin to the dough, loaf volume and bread baking quality could be maintained. The quantity of lecithin necessary for 3, 6 and 9% soya/wheat blends was determined.

AIDOO, E. S. & TSEN, C. C. **Jb2**
1973
Influence of surfactants or soy proteins on the extractability, gel filtration, and disc electro-phoretic patterns of wheat proteins
Cereal Sci. Today **18** (9). (58th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Differences caused by various surfactants in the extractability of wheat proteins, coupled with differences in gel filtration etc., indicated that surfactants and/or soya proteins admixed with wheat flour-water doughs could modify or alter the structural stability of wheat proteins, particularly glutenin and gliadin. Further, the studies indicated that wheat protein could form complexes with surfactants and/or soya proteins through hydrogen and hydrophobic bonds.
(Shortened abstract.)

AIDOO, E. S. & TSEN, C. C. **Jb3**
1973
Surfactant interactions in model systems
Cereal Sci. Today **18** (9). (58th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Interactions between 1) wheat-protein and soya-protein; 2) wheat-protein and surfactants; 3) soya-protein and surfactants; and 4) wheat-protein, soya-protein and surfactants, established in doughs, were confirmed in model systems. From the results of the study, it is suggested that a surfactant showing an improving effect on the mutiple interacting system can maintain or enhance the integrity of wheat flour proteins in the complex, so that gluten proteins, though modified, are able to accomodate the soya proteins in the gluten matrix or overcome the concomitant deleterious effects of soya flour and yield an acceptable bread.
(Shortened abstract.)

BAYFIELD, E. G. & SWANSON, E. C. **Jb4**
1946
Effect of yeast, bromate and fermentation on bread containing soy flour
Cereal Chem. **23**, 104–113

With 3–6% added soya flour in straight doughs, it was necessary to increase potassium bromate and decrease fermentation in order to produce bread of optimum volume, grain and texture. Even with 6% soya flour, proper balancing of yeast, bromate and fermentation produced bread equal to the control except for crumb colour. Soya flour reduced fermentation and baking loss in proportion to the amount added.

BEDENK, W. T. (PROCTER & GAMBLE CO.) **Jb5**
1972
High-protein cereals
USA Patent No. 3 689 279

Ready-to-eat cereal products with a protein content of over 20% after processing, are produced by combining cereal grains with a partially hydrolysed soya isolate (protein content 90–100%).

BELSHAW, F. **Jb6**
1971
Bread has 30–40% more protein, same cost
Fd Processing **32** (5), 24–25

Article by the associate editor on work by Tsen and Hoover of Kansas State University in the use of sodium stearoyl lactylate in breadmaking from wheat/soya blends.

BOHN, R. T. & FAVOR, H. H. **Jb7**
1945
Functional properties of soy flour as a bread ingredient
Cereal Chem. **22**, 296–311

Pigment content of full-fat soya flour was reduced to one third by treatment with benzoyl peroxide. Farinograph curves were not significantly affected by different brands of commercial soya flours or their heat-treatment. Lipoxidase activity was high with untreated raw bean; no correlation was found between urease activity and bread quality. The effect of soya alone on fermenting dough depends on the level of addition, but oxidising agents, which improve the dough properties, can be used in sufficient quantity to produce bread similar in character to bread from wheat. The rate of staling is slower in soya flour breads.

BROWN, H. A. & CHURCH, J. A. **Jb8**
1972
Soya flour, the modern baking additive
Industrie Alimentarie **11** (10), 109–110, 112–113. (In Italian)

Soya flour as a bakery additive, its chemical analysis, its enzymes and their action, are discussed. Experiments using 1.0, 1.3 or 1.8 kg soya flour per 127 kg flour in bread showed the 1.8 kg level to give the best results.

CARLSON, S. C., HAFNER, F. H. & HAYWARD, J. W. **Jb9**
1946
Effect of soy flour and nonfat dry milk solids in white bread on the nutritional quality of the protein as measured by three biological methods
Cereal Chem. **23** (3)

Three biological methods (nitrogen balance, growth assay and body protein storage) were employed to evaluate soya bread and milk bread at various levels of addition. 3% soya bread was equal to 3% milk bread; 5% soya bread was at least equal to 6% milk bread and both were superior to 3% soya bread, 3% milk bread and whole wheat bread. All were superior to white wheat bread.

CIRCLE, S. J. **Jb10**
1971
Functional properties of commercial edible soybean products
Abstr. of Papers, Am. Chem. Soc. 161: AGFD 36

The functional properties of soya bean protein in food formulations are dealt with, and the various soya bean fractions or combinations of fractions are categorised. Their use in various foods is described, including baked cereal goods and pasta.

DANIELS, N. W., FRAZIER, P. J. & WOOD, P. S. **Jb11**
1971
Flour lipids and dough development
Bakers' Dig. **25** (4), 20–25, 28

The composition and complexity of wheat flour lipids are discussed. Binding of flour lipids, caused by hydration of flour proteins, may have a deleterious effect on bread quality unless fat is added to the dough. High energy mixing in the presence of air releases lipid through oxidation of binding sites in the dough; full-fat enzyme-active soya flour supplies enzymes necessary for this oxidation, which also assists oxidative improvement of gluten.

DE, S. S. **Jb12**
1971
Technology of production of edible flours and protein products from soybean
FAO Agricultural Services Bulletin, AGS:ASB 11, 151 pp

Manual of soya bean processing, with tables and illustrations. Chapter 3 discusses the quality control of edible flour and grits, and Chapter 5 deals with the production of full fat soya flour.

DIAZ DELGADO, D. **Jb13**
1971
Enrichment of cereals with protein
Revta. Inst. Invest. technol. Bogotá, Colombia **13** (71), 30–44. (In Spanish)

'Provesol', prepared from dried soluble soya protein, was compared with whole dried milk for protein content, lysine per 100 g protein and PER. Results of storage trials are given. Another product consisting of an enriched pasta containing 25% wheat semolina and 75% blended soya, wheat and maize flours contained 17.8% protein, had a PER of 2.69 when cooked, and was highly acceptable in flavour.

DIMLER, R. J. **Jb14**
1967
Soybeans and corn join forces in food
Soybean Dig. **27** (12), 50

The fortification of corn flour with soya flour is discussed, with reference to content of starch, protein and oil in each. The composition of CSM (corn, soya, milk blend) is described, as is a village process for the production of full-fat soya flour. Several combinations of wheat and soya flour were evaluated in attempts to produce a soya-cereal blend for use in fermented tempeh, an oriental food traditionally made from soya beans alone. Here the problem consists in finding a mould suitable for blends of wheat or corn with soya. Animal feeding tests demonstrated that the nutritional value of wheat-soya tempeh was better than that of cooked, but unfermented, wheat-soya mixture.

FINNEY, K. F. **Jb15**
1946
Loaf volume potentialities, buffering capacity, and other baking properties of soy flour in blends with spring wheat flour
Cereal Chem. **23**, 96–104

Excellent bread can be made with blends containing up to 8% soya flour with hard red spring wheat flour, provided the quantity of potassium bromate used is increased with the soya flour substitution level. A hexane-extracted soya flour, which buffered the effects of excess potassium bromate as effectively as milk solids, was found to be the best of three soya flours used in the study. The colour change in the crumb of bread containing 4% soya flour would be unnoticed by most consumers.

FINNEY, K. F. *et al* **Jb16**
1950
Baking properties and palatability studies of soy flour in blends with hard winter flours
Cereal Chem. **27**, 312–321

Commercial winter wheat flour (13.9% protein) was baked with 4% and 8% of hexane-extracted, full-fat and ethanol-extracted soya flour. Excellent bread was produced, crumb grain and loaf volume being equal to the control provided the level of potassium bromate was increased. The palatability studies indicated that bread from wheat flour alone was preferred to the soya/wheat blend.

FINNEY, K. F. & SHOGREN, M. D. **Jb17**
1971
Surfactants supplement each other, make foreign proteins compatible in bread-making
Bakers' Dig. **45**, (1), 40–41

In breadmaking studies using 4 g milk solids or 12 g soya flour in the formula, sodium stearoyl-2-lactylate produced better bread than twice the amount of calcium stearoyl-2-lactylate. Pluronic polyol F108 at low levels is more effective than either SSL or CSL. Replacement of shortening with 2.5 g sucrose tallowate was more effective than the above three improvers. Combinations of improvers were also tried and the results are reported.

GAVRILOVIC, M. **Jb18**
1972
Use of soyflour in the production of pasta
Hrana i Ishrana **13** (5/6), 278–280. (In Serbo-Croat)

Pasta (macaroni) containing 24% protein, was produced from 20% soya flour. Cooking quality was satisfactory, but flavour and aroma could be improved if technical developments resulted in a more satisfactory soya flour for use in pasta products.

HAMDY, M. M.
1969 **Jb19**
Why not soya?
Baking: kernel to consumer. *Symposium, American Ass. of Cereal Chemists,* (114 pp), pp 63–73

The use of soya flour and protein in baked goods is discussed.

HORAN, F. E. Jb20
1973
Wheat-soy blends. High quality protein products
Cereal Sci. Today 18 (1), 11–14

Wheat soya blend (WSB) is a mixture of bulgur flour, soya oil, minerals and vitamins. When added to cereal foods it increases protein content and improves amino acid balance, especially by increasing lysine.

HOOVER, W. J. Jb21
1971
Blend K bread
Soybean Dig. November 1971

Bread is the most likely vehicle for nutritional improvement of diets in the developing world. Blend K was developed to overcome some of the technical barriers to the enrichment of bread with soya protein, and consists of 100 parts wheat flour, 12 parts soya flour and 0.5 parts sodium stearoyl lactylate plus vitamins and minerals.

HYDER, M. A., HOSENEY, R. C., FINNEY, K. F. & SHOGREN, M. D. Jb22
1972
Soy-flour fractions in breadmaking and their interaction with wheat-flour components
Cereal Sci. Today 17 (9). (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Three fractions were obtained from the protein of de-fatted commercial soya flour, one of these being an insoluble residue. The pH 4.5 isoelectric protein fraction blended with wheat flour, with addition of sucrose monotallowate, gave a loaf volume comparable to the controls of soya flour/wheat flour/SMT. The pH 4.5 water-soluble fraction gave reduced loaf volume, and attempts to isolate the deleterious substance were unsuccessful. An interaction between wheat flour, SMT and soya protein was demonstrated. The isoelectric fraction, SMT and gluten interact during dough mixing.
(Shortened abstract)

JOHNSON, D. W. Jb 23
1969
Oilseed proteins — properties and applications
Fd Prod. Development 3 (8), 78, 82, 84, 87.

Soya flour and grits are discussed in relation to their application in the production of baked goods and processed meats.

KIRLEIS, A. W., ROBINSON, R. J. & HOOVER, W. J. Jb 24
1971
Some effects of soy-protein concentrate on dough and bread characteristics
Cereal Sci. Today. 16 (9) (56th Annual Meeting, American Ass. of Cereal Chemists, 1971). Abstract only.

The effects of fine, medium and coarse grinds of 70% commercial soya protein concentrate on dough properties and baking potential were studied. Increasing levels of addition gave increased 'strength' on the Farinograph and increased resistance to extension. In the baking trials increasing levels gave decreasing loaf volume. Bread made by the continuous method was least affected.
(Shortened abstract)

LEARMONTH, E. M. **Jb 25**
1951
Influence of soya flour on bread doughs. I A papain-inhibiting factor in soya beans
J. Sci. Fd Agric. **2**, 447–449.

Aqueous extracts of raw soya beans are shown to inhibit the action of papain on a gelatin substrate. The strength of the inhibiting effect is compared with that of peroxide. Heating the extract weakens the inhibitor.

LEARMONTH, E. M. **Jb 26**
1952
The influence of soya flour on bread doughs. II The inhibition of the proteolytic enzymes of malt and wheat flours
J. Sci. Fd Agric. **3**, February 1952.

Aqueous extracts of soya beans are shown to inhibit the proteolytic enzymes of malt on a gelatin substrate and those of wheat flour and papain, on a gluten substrate. The effect of the inhibitor is compared with that of potassium bromate.

LEARMONTH, E. M. **Jb 27**
1958
The influence of soya flour on bread doughs. III The distribution of the papain inhibiting factor in soya beans
J. Sci. Fd Agric. **9**, May 1958.

The papain-inhibiting factor of soya is shown to be concentrated almost entirely in the germ. The cotyledon is without inhibiting power and sometimes has a slight activating effect. A similar distribution of papain-inhibiting factors is shown to exist in other leguminous seeds. Additions of 0.2% to 0.4% of raw soya germ alter the Chopin alveogram of the wheat flour in the same sense as do additions of oxidising improvers.

LEARMONTH, E. M. & WOOD, J. C. **Jb 28**
1960
The influence of soya flour in bread doughs. IV Alpha-amylase of soya
Cereal Chem. **37**, 158–169.

The existence in raw soya of a starch-liquefying enzyme as demonstrated by the amylograph is confirmed. The enzyme is chiefly, if not wholly a true alpha-amylase. The activity of soya is only of the order of 1/100th of that of an ordinary wheat malt, and it diminishes rapidly with rising temperature and with falling pH, in contrast with that of wheat malt. These results contradict the findings of some other workers and lead to the conclusion that the alpha-amylase activity of raw soya is not significant in commercial breadmaking.

LORENZ, K., BOWMAN, F. & MAGA, J. **Jb 29**
1971
Special dietary breads
Bakers' Dig. October 1971, pp 34–40.

The author discusses sodium-restriction and alternatives to saturated fats in bread used for dietary treatment of various diseases. Trials were made to improve the flavour of low-sodium bread by addition of high-protein additives, de-fatted soya flour being the most satisfactory.

MARNETT, L. F., TENNEY, R. J. & BARRY, V. D. **Jb 30**
1973
Methods of producing soy-fortified breads

Cereal Sci. Today **18** (2).

A study was made of 70% sponge dough, straight dough and 100% sponge dough procedures to produce 12%-fortified bread. Proper dough mixing and absorption, and use of sodium stearoyl-2-lactylate were found to be the most important factors in producing high-quality soya-fortified breads.

MARNETT, L. F., TENNEY, R. J. & BARRY, V. D. **Jb 31**
1973
The effect of storage times and temperatures on the baking characteristics of 12% fortified flour

Cereal Sci. Today **18** (2), 53–57.

Samples of soya-fortified flour, de-fatted soya flour and baker's patent flour were stored for up to one year at temperatures from −10 to 110°F. De-fatted soya flour showed no deterioration in baking quality after one year and no flavour changes for 6 months at 100°F. Soya-fortified flour stored at 100°F for 6 months gave better bread than the patent flour under the same conditions. Deterioration in baking quality of soya blends during storage is largely dependent on the stability of the patent flour.

MECHAM, D. K. *et al* **Jb 32**
1972
Soy-fortified wheat flour blends: storage stability of baking performance and flavour

Cereal Sci. Today **17** (9). (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Bread from full-fat and de-fatted soya/wheat flour blends (12:100, some with 0.5% SSL) and the separate ingredients were subjected to storage tests under varying conditions. Six months at 13% moisture and 100°F resulted in steady loss of loaf volume. Off-flavours also developed. The full-fat soya blends showed no loss of volume under less severe conditions, while the treated soya blend showed greater shrinkage than the 100% wheat control. (Shortened abstract).

MECHAM, D. K., HANAMOTO, M. M., BEAN, M. M. & FELLERS, D. A. **Jb 33**
1973
Soy-fortified wheat flour blends. Comparisons of surfactant additive in stored samples

Cereal Sci. Today **18** (9). (58th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

Samples of wheat/soya flour blends containing 6% and 12% soya flour were treated respectively with 0.28% and 0.5% of sodium stearoyl lactylate or ethoxylated monoglyceride-monoglyceride combination (EMG), and stored for up to 6 months at 100°F and varying moisture levels. Samples were removed at intervals for baking. The overall results at the end of 6 months showed that at 12.4 and 12.7% moisture, loaf volume losses were greater with SSL than with EMG. At 10% moisture the SSL blends maintained satisfactory performance at 100°F for 6 months. (Shortened abstract)

MENGER, A., BRETSCHNEIDER, F. & STEPHAN, H. **Jb 34**
1973
New experiences with the use of soya products in bread and bakery products
Getreide, Mehl und Brot. **27** (5), 154–160. (In German).

Technological, nutritional and legal aspects of the use of soya products in baking, and recent experimental work, are reviewed. Soya was added in the form of semolina, flour or protein concentrate to various baked goods, including bread, biscuits and cake, and results confirmed the advantages of using soya protein in baked goods containing fat and sugar.

MILLERS' NATIONAL FEDERATION **Jb 35**
1973
Soy fortified flour
Millers' National Federation, Washington, D.C.

Booklet setting out the composition and uses of soya-fortified wheat flour, and giving formulae for its use in breads of various kinds, rolls, cookies, noodles, doughnuts, etc. at 6% and 12% levels of enrichment.

MIZRAHI, S., ZIMMERMAN, G., BERK, Z. & KOCAN, U. **Jb 36**
1957
Use of isolated soybean protein in bread
Cereal Chem. **44** (2), 193–203.

Admixture of soya bean proteins was found to increase the water absorption capacity of the flour, and, with rising addition levels, to decrease the loaf volume, which, in mixes containing less than 6% protein, could be counteracted by adding 1% lecithin. Levels of addition up to 8% had no significant effect on flavour and the PER increased with the percentage of isolate in linear relation to the lysine content of the bread. It was concluded that soya bean protein may be admixed with wheat flour at levels of up to 6% without impairment of over-all acceptability.

MUGLER, D. J., MITCHELL, J. D. & HURLEY, W. C. **Jb 37**
1967
Utilizing soy protein concentrates in bread
Cereal Sci. Today **12** (3). (52nd Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

A specialty bread was baked by straight dough and sponge dough procedures, incorporating soya bean protein concentrates at two levels of addition and in three different granulations. Loaf volume was estimated. Results of consumer acceptance trials were favourable. Nutrition studies indicated that soya protein concentrate increased the nutritive value of the bread both when used alone and when combined with non-fat dried milk. (Shortened abstract).

OFELT, C. W., SMITH, A. K. & DERGES, R. E. **Jb 38**
1954
Baking behaviour and oxidation requirements of soy flour. I Commercial full fat soy flours
Cereal Chem. **31**, 15–22.

The effect on baking properties of 5% full fat soya flour added to wheat flour was studied. It was found that the addition of 1.0–3.0 mg% (on wheat flour basis) of potassium bromate counteracted almost completely the detrimental effect usually found. Water-soluble nitrogen of the best grades of soya flour amounted to 35–40%. Water absorption was increased 0.8% for each % of soya flour added.

OFELT, C. W., SMITH, A. K. & MILLS, J. M. **Jb 39**
1954
Baking behaviour and oxidation requirements for soy flour. II Commercial de-fatted soy flours

Cereal Chem. **31**, 23–28.

With the proper amount of oxidation, the addition to wheat flour of up to 5% soya flour had no significant effect on bread. Nitrogen solubility of de-fatted soya flours was 50–60% and the bromate requirements 3.0–4.0% (on wheat flour basis) where soya flour level was 5.0%. An increase in dough absorption of 1% to each % of soya flour was found desirable.

PAULSEN, T. M. & HORAN, F. E. **Jb 40**
1965
Functional characteristics of edible soya flours

Cereal Sci. Today **10**, 14–17.

Flours were baked by a straight-dough formula with 3% soya, and compared with a 3% NFDM control. The only adjustment in the formula was an increase of 1% in water added to the soya dough. No conclusive indication was obtained as to any one functional characteristic of soya flour which would pre determine its function in breadmaking. However, it is apparent that the functional characteristics of edible soya flours can be affected by the method of processing the soya.

POLLOCK, J. M. & GEDDES, W. F. **Jb 41**
1960
Soy flour as a white bread ingredient. I Preparation of raw and heat-treated soy flours, and their effects on dough and bread

Cereal Chem. **37**, 19–29.

An experimental de-fatted soya flour was prepared and equated with a commercial product. Controlled heat treatment at 73°C and 100°C were compared. Baking tests are described in which raw and heat-treated soya flour were added to dough at levels of 1–5%.

POLLOCK, J. M. & GEDDES, W. F. **Jb 42**
1960
Soy flour as a white bread ingredient. II Fractionation of raw soy flour and effects of the fractions in bread

Cereal Chem. **37**, 30–54.

The authors describe the incorporation in flour doughs of raw de-fatted soya flour and its fractions, and the effect on baking performance. Fractions found to be injurious to doughs were analysed for inorganic constituents and the conclusion is drawn that these may be of relatively little importance in the performance of soya flour itself.

POMERANZ, Y. **Jb 43**
1966
Soyflour in breadmaking

Baker's Dig. **40** (3), 44–48, 78.

A review of the chemical composition, nutritional value and functional properties of soya flour. 54 references.

Jb 44

POUR-EL, A.
1971
Soybean components in cereal flours
Soy the wonder bean, Symposium, American Ass. of Cereal Chemists, pp 93–111.

Jb 45

ROY, D. K.
1970
The development of new soy protein supplements for undernourished people of India
Dissertation Abstracts International. Section B. The Sciences and Engineering. **30** (11) 5090–5091.

Four protein formulations were tested, consisting of varying concentrations of isolated soya protein in mixes with rice, chick peas and corn. Sensory tests showed no significant differences between formulations. Rat feeding trials indicated protein levels to be about comparable to 27% casein. Some costing is included in the paper.

Jb 46

SHAMSUDDIN, M.
1972
Evaluation of breads containing protein supplements and sodium stearoyl-2 lactylate or sucrose tallowate
Dissertation Abstracts International. Section B. **33** (5), 1867, Order No. 72–28 862.

12% soya bread containing SSL and ST was compared to commercial enriched white bread containing 3% non-fat dry milk. Soya bean bread was significantly superior in promoting growth and protein utilisation, and contained higher levels of essential amino acids, lysine content being almost doubled. Bread with 14% milk solids had a lower available lysine content than soya-supplemented bread.

Jb 47

TSEN, C. C. & TANG, R. T.
1971
High-protein breads. I Soy flour bread
Bakers' Dig. **45** (5), 26–7, 30–2.

A baking method was developed for 12% soya bread; the use of improvers, the influence of fermentation time and yeast level and the influence of bromate are described.

Jb 48

TSEN, C. C.
1971
New concepts for use of soy flour in baking
Soy the wonder bean, Symposium, American Ass. of Cereal Chemists, pp 112–131.

TSEN, C. C. *et al* Jb 49
1972
Preparation of high-protein baked foods from wheat-soy blends and explorations of interactions of wheat-soy proteins
Cereal Sci. Today **17** (9). (57th Ann. Meeting, American Ass. Cereal Chemists) Abstract only.

In addition to preparation of a variety of high-protein baked foods, basic studies were conducted to determine wheat-soya protein interactions in doughs and model systems. Soya proteins were found to interact with wheat glutenin and gliadin components through hydrogen and hydrophobic bondings. Additions of dough conditioners could change greatly the electrophoretic patterns of the proteins and their complexes. (Shortened abstract).

TSEN, C. C. & HOOVER, W. J. Jb 50
1973
High-protein bread from wheat flour fortified with full-fat soy flour
Cereal Chem. **50**

Fortification of wheat flour with full-fat soya flour can raise the protein content, balance essential amino acids and increase calorific value, but baking quality can be impaired. Sodium stearoyl-2 lactylate (SSL) could increase stability in dough containing 12–28% soya flour. 0.5% SSL produced an acceptable loaf from up to 24% soya flour in the dough. Baking quality of de-fatted soya flour was less satisfactory. SSL helped stored breads to retain softness.

TURRO, E. J. & SIPOS, E. Jb 51
1968
Effects of various soy protein products on bread characteristics
Bakers' Dig. **42** (6), 44–50, 61.

Soya flour, chemically treated (de-bittered) soya flour and special process soya flour (Textrol in the USA) were compared in a sponge and dough American bread formula. They were also used in blends with non-fat milk solids and whey solids.

TURRO, E. J. Jb 52
1970
Bakery formulation
USA Patent No. 3 529 970.

Water absorption is improved in bread doughs by the addition of mixtures of soya flour and soya protein concentrate.

TURRO, E. & SIPOS, E. Jb 53
1973
Special soy protein product for breadmaking
Baker's Dig., June 1973, 30–34, 38.

The authors describe the use in breadmaking of a soya product, buffered by the addition of calcium lactate, calcium sulphate and ascorbic acid, with an average protein content of 52%. Tables illustrate the analytical and physical properties of the soya product, which can serve as a complete replacement for non-fat dry milk in breadmaking.

WESTERMAN, B. D., OLIVER, B. & MAY, E. Jb 54
1954
Improving the nutritive value of flour. II A comparison of the use of soy flour and wheat germ
J. Nutr. **54**, 225.

WILLIAMS, L. D., SIPOS, E. & ZIEMBA, J. V. **Jb 55**
1970
Makes baked goods more nutritious
Fd. Engng. **42** (12), 59–61.

Textrol, a 60%-protein soya flour can be used on its own or in blends with other protein supplements to improve the nutritional quality of baked products. Formulae are given for Textrol-bread and high-protein cookies. Textrol can be used as a substitute for non-fat dried milk in cakes (cost is half as much in the USA) and can be incorporated in cake mixes, biscuit doughs and bread rolls.

WOOD, J. C. **Jb 56**
1971
Soya flour's place in the baking industry
Bakery Management No. 517, 17–18, 21.

Review of the use of soya flour in biscuits, sponge goods and pastry products.

YASUMATSU, K. *et al* **Jb 57**
1972
Effects of addition of soybean products on dough properties
Agric. biol. Chem. **36** (5), 729–735.

The addition of 5% soya bean products increased water absorption and stability of wheat flour.

See also
A. 8:19:22:26
B. 2:10–13:15:19:20:22–24:28:33:37
C. 1:4:5
D. 4:6–8:12:14:15:18:22
E. 2
F. 9:10:14:18:21:34
Gb. 7:10:18
Gd. 6
Ha. 2
Ja. 5:10:11:14:17:18:21:27:29:34:36:38:40–43:46:48:52:55:61:69
Jd. 4:7–9:12
Jk. 4:6:8:14
Jm. 16:17
Jn. 1
Jo. 9
Jp. 2

Groundnut

BAINS, G. S., BHATIA, D. S. & SUBRAHMANYAN, V. **Jc 1**
1963
Studies of protein-rich biscuits based on peanut flour
J. Proc. Oil Technol. Assn., India, **18** (Part II), 219–224.

MURTHY, H. B. N. *et al* **Jc 2**
1950
Supplementary value of groundnut cake to tapioca and sweet potato
J. Sci. industr. Res. India, 9B (7), 173–176.

Addition of groundnut cake flour to diets largely composed of tapioca or sweet potato flour promotes good growth in young rats, whereas rats fed on tapioca or sweet potato flour containing pulses and vegetables lost weight. Animals fed on a poor rice diet in which 25% rice was replaced by a mixture of 4 parts tapioca or sweet potato flour and 1 part groundnut cake flour also grew well.

NIPPON OILS & FATS CO. LTD. **Jc 3**
1973
Peanut cereal food
Japanese Patent No. 4808507.

Cereal flours are combined with 30% ground peanut kernels and, together with oils and fats, are extruded to yield a peanut/cereal food product.

SHURPALEKAR, S. R. & BRETSCHNEIDER, F. **Jc 4**
1969
High protein biscuits containing groundnut protein isolate
Pl. Foods hum. Nutr. **1**, 247–51. Pergammon Press.

A process is described for the preparation of high protein biscuits containing groundnut protein isolate and fortified with vitamins and minerals. The product contained 29% protein and was organoleptically acceptable to a panel of judges. When packed in different packaging materials the biscuits kept well for a period of 5 months at room temperature. A daily supplement of 7 biscuits costing less than 3d provides nearly one third of the daily requirements of protein and certain vitamins and minerals of young children.

SUBRAHMANYAN, V. *et al* **Jc 5**
1955
Effect of storage on the chemical composition and nutritive value of groundnut flour, tapioca flour and their blends
Bull. Cent. Fd Technol. Res. Inst. **4** (1), 31–33.

Tapioca flour (A), expeller-pressed groundnut cake flour (B) and blends of the two at 4:1 (C) were stored at room temperature (72–91°F) and at 98.6°F for 5 months. Changes noted were: slight loss of thiamine in all samples, increase of free fatty acids and peroxide value in the fat of B and C, slight rancidity in B. No appreciable difference was caused by the temperature. Five months' storage caused no appreciable reduction in the overall nutritive value of the C samples, or in the biological value of the B samples.

See also
A. 4:19:26
B. 11:13:15:19:22–24:33:37
C. 4
D. 1:14:20:21
E. 3
F. 4:6:11:12:16:17:19:20:24–33:36:37
Gc. 13:15
Gd. 11
Ha. 1:2
Hb. 3:9–11
He. 7
Ja. 1:2:10:17:21:34:38:42:61:66:67
Jd. 4:6:8:9:12:13
Je. 2
Jj. 1

Cotton seed

ANON.
1971 **Jd 1**
Baked foods, meats, beverages, high-protein foods from cottonseed
Fd Processing **32** (4), Suppl. F4–F6.

A liquid cyclone process for removing gossypol from cottonseed is briefly described. The process can give a product containing 67–70% protein, from which biscuits can be made (5, 10 and 20% cottonseed flour). Only the major isolate was suitable for 10% replacement of wheat flour in sponges and dough formulations.

BACIGALUPO, A. *et al* **Jd 2**
1967
Bread enrichment with protal – Peruvian cottonseed flour
Cereal Sci. Today **12** (10), 431–432, 434–437.

Protal, a cottonseed protein concentrate, when added to Peruvian white bread at levels of 5–10% of flour weight, gives acceptable bread of good volume, crumb and crust texture and of improved nutritional value.

FOGG, N. E. & TINKLIN, G. L. **Jd 3**
1972
Influence of glandless cottonseed flour on quality, acceptability and amino acid content of sugar cookies
Cereal Sci. Today **17** (3), 70–74, 92.

Glandless cottonseed flour was used to replace various proportions of wheat flour in plain sweet cookies, and had a generally adverse effect except on nutritional value, which was improved. Addition of 6% fine cottonseed flour was adjudged most acceptable.

FORMO, M. W. **Jd 4**
1971
The oilseed industry of India – potential for food use of proteins
J. Am. Oil Chemists Soc. **48** (10), 619–624.

The cultivation and processing of oilseeds available in India, and the protein products derived from them (groundnut flour, isolated groundnut protein, cotton seed flour and soya flour) are discussed. Their use in atta, bread, dhal, bal ahar (wheat/groundnut flour blend) and other foods is reported.

HARDEN, M. **Jd 5**
1971
Baking with cottonseed flour may become reality in near future
Cotton Gin and Oil Mill Press, September 4, pp 12–14.

Survey of progress in the USA in the use of cotton seed flour in bread, snack foods, crackers, candy and cakes. Mention is made of a cookie containing 100% cotton seed flour, and of other baked products with a cotton seed flour content of 30–40%.

Jd 6

KHAN, M. N. *et al*
1973
Bread-baking properties of wet-processed, glandless cottonseed protein concentrates spray- or freeze-dried at different pH levels

Cereal Sci. Today, 18 (9). (58th Ann. Meeting American Ass. Cereal Chemists) Abstract only.

Cotton seed concentrates were prepared at different pH levels by freeze and spray drying, and blended with wheat flour to produce blends with 40% more protein than the control. Soya protein concentrate was included for comparison. Bread baked with the cotton seed concentrate spray dried at pH 7.5 had the best overall quality. Bread baking properties were poor where the concentrates were either freeze or spray dried at pH 4.5. Groundnut protein concentrate spray dried at pH 4.0 and 7.0 did not differ in baking properties, and it would appear that cotton seed and groundnuts differ significantly in optimum processing requirements for use in bread making. (Shortened abstract).

Jd 7

LYMAN, C. M.
1969
Nutritional value of cereal oilseed protein mixtures

USDA Publication, ARS 72–71. *(Proc. Conf. on Protein-rich Food Products from Oilseeds, New Orleans,* May, 1968).

The feasibility of varying the composition of protein-rich material used in the standard CSM food mixture distributed by the USDA was studied. Replacement of 50% or more of the soya flour with glandless cotton seed flour resulted in lower PER, whereas replacement of all the soya flour with cotton seed flour plus lysine resulted in higher PER values. In general, substitution of grain sorghum for corn resulted in lower PER values. The amino acid balance of the various mixtures is discussed.

Jd 8

MATTHEWS, R. H.
1969
Some principles for the use of oilseed flours in cereal products to improve consumer acceptance

USDA Publication, ARS 72–71 *(Proc. Conf. on Protein-rich Food Products from Oilseeds, New Orleans,* May, 1968).

The specific functions of various oilseed flours (cotton seed, groundnut, safflower and soya) in doughs was studied using high levels of replacement: 15–35%. The results led to the recommendation that oilseed flour should be blended uniformly with wheat flour by sifting; that more fluid doughs should be used; that coarser ground oilseed flours can be used when available; that drastic modifications in dough formulations are called for when replacement levels exceed 25%.

Jd 9

MATTHEWS, R. H.
1972
Some functional aspects of oilseed flours in bread

Bakers' Dig. 46 (2), 46, 48, 78. See also *Cereal Chem.* 1970, 47 (2), 181–189.

Adding oilseed flours such as cotton seed, groundnut, safflower seed and soya to doughs usually reduced mixing tolerance and loaf volume. A modified soft-dough method with reduced mixing and fermentation times brought improvement in texture. There was found to be more complete gelatinisation of starch in the soft doughs, with uniform distribution of carbohydrate and protein bodies.

OLSON, R. L.
1973 **Jd 10**
Evaluation of LCP cottonseed flour
Oil Mill Gazetteer **77** (9), 7–8.

Further evaluation work on LCP (liquid cyclone process) cotton seed flour is reported. One experiment referred to involved the use of LCP (3%) in white bread, where apart from a slight darkening of colour, the result was excellent. LCP flour was also desirable in cakes, except where the resulting colour was unacceptable.

ROBINSON, R. J., SANCHEZ, C., KHAN, M. & HOOVER, W. J. **Jd 11**
1971
Effect of protein supplementation (cottonseed flour) on American and India-Pakistani bread
Cereal Sci. Today **16** (9) (56th Annual Meeting, American Ass. of Cereal Chemists) Abstract only.

The protein content of two types of wheat flour was increased by adding up to 30% cotton seed flour. Above the 15% level of addition the cotton seed flour depressed loaf volume and impaired flavour. Nan and chapatis baked from blends containing 8% cotton seed flour resulted in good products. (Shortened abstract).

SCHLOSSER, G. C. & DAWSON, E. H. **Jd 12**
1970
Cottonseed flour, peanut flour and soy flour: formulae and procedures for family and institutional use in developing countries
Rep. USA Dept. Agric., July 1969, ARS 61–7, 50 pp.

Basic formulae, food combinations and preparation procedures suitable for use by families and community groups were developed for flours made from cotton seed, groundnuts and soya beans. Formulae for cotton seed flour were limited to breads and cereal products. The formulae are intended as guidelines for using the flours in everyday meals, and are adaptable to flavour modification to suit local taste preferences.

SHEIKH, I. A., ISHAQ, R. & ALI, S. M. **Jd 13**
1970
Preparation and evaluation of high protein breads containing oilseed protein concentrates
J. scient. ind. Res., Pakistan, **13** (1–2).

Breads were made containing protein concentrates from cotton seed, rapeseed and groundnut cake. Skim milk powder, vitamins and minerals were also added. Breads with blends of the concentrates plus skim milk powder were found to be superior in all respects to that made of wheat flour alone, and slightly inferior to that containing skim milk powder as the only additive.

See also
A. 19:26
B. 9:11:13:37
C. 1
D. 1
Gc. 13
Ha. 2
Ja. 10:29:34:42:61
Je. 2
Jp. 2

Sunflower

BURNS, E. E., TALLEY, L. J. & BRUNMETT, B. J. **Je 1**
1972
Sunflower utilisation in human foods
Cereal Sci Today **17** (9), 287–289, 298.

A major problem of de-fatted sunflower meal in baked products is discoloration due to oxidation of chlorogenic acid. The meal was quite acceptable in products with a normal pH of 5 to 7; good colour, flavour and stability were demonstrated under various storage conditions, and products were acceptable when processing did not induce oxidation of chlorogenic acid.

ROONEY, L. W., GUSTAFSON, C. B., CLARK, S. P. & CATER, C. M. **Je 2**
1972
Comparison of the baking properties of several oilseed flours
J. Food Sci. **37**, 14–18

When used with wheat for yeast-leavened bread the properties of sunflower and cotton seed flours respond positively to heat treatment, while for baking, sesame and groundnut are slightly impaired, though mixing properties are slightly improved. Each oilseed has an optimum heat requirement.

See also
A. 19: 26
Ha. 2
Ja. 9: 34: 61

Rape

(Jf)

See
- A. 19: 26
- F. 18
- Ha. 2
- Ja. 2: 34: 61
- Jd. 13

Coconut

DENDY, D. A. V. & TIMMINS, W. H. **Jg 1**
1973
Development of a wet-coconut process designed to extract protein and oil from fresh coconut
Tropical Products Institute Report G 78.

The report contains some information on breadmaking with cassava starch and coconut protein isolate.

GRIMWOOD, B. E., RICHARDS, C., BONE, R. T. & ROSE, H. M. **Jg 2**
Nutritional value of coconut protein concentrate used as a partial replacement of wheat protein in bread
Tropical Products Institute

Bread made from 50% wheat, 43.8% cassava flour and 6.2% coconut protein concentrate was analysed for protein content and fed to rats, using a standard wheat loaf as control. After 10 days the rats were killed, the carcases dried and the body nitrogen determined. The NPU values showed the coconut loaf to compare very favourably with the control though the results must be considered tentative.

See also
A. 19: 26
B. 10–13
Ha. 2
Ja. 2: 12: 34: 37: 61: 66: 67

Sesame, safflower, etc.

JAFFE, W. G. & CHAVEZ, J. F. Jh 1
1971
El posible uso de harina de ajonjolí para fines comestibles
Arch. Lat. Nutr. (Venezuela), **21** (1), 31–48

See also
A. 19:26
Gd. 11
Gg. 1
Ha. 2
Ja. 34: 38: 43: 61
Jd. 8: 9
Je. 2

Legumes

BAINS, G. S. & TARA, K. A. **Jj 1**
1967
To develop improved types of bread
Annual Report, Central Food Technological Research Institute, Mysore, Jan.–Dec. 1967

Flours of lentil and gram added at levels above 5% to wheat flour adversely affected grain and volume of bread. Better volume was obtained by adding groundnut flour and texture and grain were improved by incorporating 0.25% sodium stearoyl fumarate to the flour. Meal samples collected from Indian mills and fortified with wheat protein were found to be less suitable for bread baking but quite suitable for unleavened bread. Loss of added lysine in chapati cooked on an open fire was far below the losses for leavened bread. Further studies in stability of added lysine in unleavened traditional bread were made, and the results are given.

GANAPATHI, S. *et al* **Jj 2**
1958
Supplementary relations of the proteins of horse gram and cow pea to those of Italian millet
Fd Sci. **7** (1), 7–8

Italian millet *(Setaria italica L.)* is a dietary staple for the poor in certain regions of India. Supplementation of Italian millet with horse gram *(Dolichus biflorus)* and cowpea *(Vigna catjang Endl.),* two of the cheapest pulses available in India, established in the blend a balance of amino acids deficient in the separate constituents.

LUH, B. S. & MANEEPUN, S. **Jj 3**
1973
Utilisation of dry lima beans for high-protein bread
Confructa **18** (1/2), 54–62

Lima bean protein concentrate (LPC) and lima bean powder (LBP) were prepared by extraction and freeze drying respectively, and added to wheat flour at rates of 3 – 30% by weight. Both supplements increased water absorption of the dough and water retention in the loaf, reduced the loaf volume of white bread and caused slightly increased yellowness of the loaf. Some loss of organoleptic quality occurred at additions in excess of 3% LPC and 10% LBP. Detailed analyses are given.

PATEL, K. & JOHNSON, J. A. **Jj 4**
1972
The effect of horsebean-protein supplement on physical dough properties and baking characteristics
Cereal Sci. Today **17** (9), (57th Ann. Meeting, American Ass. of Cereal Chemists) Abstract only.

5 – 20% levels of horsebean flour in wheat flours of varying strength were studied for physical and baking characteristics. Breads were also made with isolated horsebean protein. The effects of steam treatment, surface active agents and ascorbic acid on horsebean flour were also examined. Levels of 5 – 10% horsebean flour gave loaf volume comparable to the control; at higher levels, strong wheat flour was necessary. With equivalent levels of isolate, acceptable bread was made even at 20% replacement, with no beany flavour, loaf volume being proportional to the wheat flour quality. Steam treatment of the horsebean flour increased the loaf volume. (Shortened abstract)

POKROWSKII, A. A. *et al* **Jj 5**
1970
Preparing dough
USSR Patent, 29 861
(In Russian)

Legume flour, e.g. pea flour, is introduced into the dough, the quality of the bread being improved by prior deodorisation of the legume infusion, followed by its fermentation by lactic acid bacteria.

SANCHEZ, C., KAHN, M., TSEN, C. C. & ROBINSON, R. J. **Jj 6**
1971
High protein Moroccan bread
Cereal Sci. Today **16** (9), (56th Annual Meeting, American Ass. of Cereal Chemists). Abstract only.

Indigenous chickpea and horsebean flour were added to a base flour available in Morocco and baked according to local formula and procedure, with sucrose tallowate or sodium stearoyl-2-lactylate as improvers. Soya flour was used for comparison. The Moroccan bread was able to carry higher levels of fortification, without objectionable effect, than American bread. (Shortened abstract)

SHEHATA, N. A. & FRYER, B. A. **Jj 7**
1970
Effect of chickpea flour on protein quality
Cereal Chem. **47** (6), 663–670

Supplementing wheat flour with 10 or 20% chickpea flour did not alter the overall acceptability of Egyptian bread, and produced a significantly higher protein efficiency ratio.

See also
A. 4: 26
B. 6: 9: 18
C. 2: 4
D. 8: 10
E. 3
F. 33
Hb. 11
Ja. 6: 38: 51: 61: 66: 67
Jb. 27: 45
Jc. 2

Gluten, wheat germ, wheat protein concentrate

BOLLING,H., el BAYA, A. W. & ZWINGELBERG, H. **Jk 1**
1973
Wheat germ fat and wheat baking quality
Getreide, Mehl und Brot, **27** (3), 92–94
(In German)

A series of milling and baking trials was undertaken to evaluate the role of lipids in baking and to determine the effects of wheat germ flour and oil on bread quality. Baking trials using lipid-free starch and fat-free flour showed that polar lipids have a considerable influence on the baking quality of flours. Wheat germ flour depressed loaf volume, while wheat germ oil increased the specific volume of the loaf.

CARVAJAL, M. J. **Jk 2**
1970
Isolation, characterisation and breadmaking properties of wheat germ fractions
Dissertation Abstracts International. Section B. The Sciences and Engineering **30** (12), order no. 70–9868.

A variety of products obtained from wheat germ by extraction and other methods is listed. In general, wheat germ proteins contained a higher concentration of lysine, threonine and valine than gluten proteins. Breadmaking trials with germ-enriched flour are reported. The bread was sweeter, darker and coarser than conventional bread.

FOOD AND AGRICULTURE ORGANISATION **Jk 3**
1970
The composite flour concept: a scientific approach to satisfying a world need
FAO/Industry Co-operative Programme, Food Industries and Marketing Subgroup, AGS:G/70/13.
See also *FAO Composite flour programme, Documentation package* Vol. 1 (revised, 1973)

Recommendations resulting from a meeting of twelve representatives of leading industrial and government research institutes in the Netherlands to discuss the definition of a research programme likely to lead to the production of a substitute or synthetic gluten.

KISSELL, L. T., MARSHALL, B. D. & YAMAZAKI, W. T. **Jk 4**
1973
Protein supplementation of cookie flours with vital wheat glutens
Cereal Sci. Today **18** (9), (58th Ann. Meeting, American Ass. Cereal Chemists). Abstract only.

Cookie baking performance of wheat flour fortified with increasing levels of three vital wheat glutens was compared with results obtained with similar blends using five soya-derived protein concentrates. Least reductions in baking quality were obtained with commercial vital glutens. Other conclusions drawn from the experiments are reported. (Shortened Abstract)

KULP, K. **Jk 5**
1970
Wheat protein concentrate in baked goods

Report of 6th national conference on wheat utilisation research, USDA Agric. Res. Service, ARS 74–54 (August 1970).

OZIMKOVA, S. N. *et al* **Jk 6**
1970
The quality of gluten

Khlebopekarnaya i Konditerskaya Promyshlennost', **14** (7), 20–21.

Mixes of maize, soya flour and non-fat dried milk inoculated with lactic acid bacteria were studied for their effect on the quality and quantity of gluten in wheat flour. Soya flour and dried milk improved the nutritional value of the bread. Of the fermentation products investigated, lactic acid had the best effect on gluten. Tables show the quality of the flour admixtures and gluten used in the experiments.

POMERANZ, Y. **Jk 7**
1970
Germ bread

Bakers' Dig. **44** (6), 30–33

The author reviews the literature on the nutritive value of wheat germ and the effect of adding treated and untreated germ to bread doughs. In his own work on lipids in germ-enriched bread he demonstrates that some of the phospholipids are better improvers than others, and makes recommendations of some commercial lecithins for incorporation in germ-enriched bread.

POMERANZ, Y. **Jk 8**
1970
Phosphatides in baking wheat-germ bread

Fd Technol. **24** (8), 927–928

Bread was baked with 15 or 30% heat-treated de-fatted wheat germ and 2–4% commercial soya bean phosphatides. Phosphatides fractionated according to solubility in alcohol and hydroxylated phosphatides were more effective than natural phosphatides in eliminating the undesirable effects of wheat germ on loaf volume and crumb grain, and a hydroxylated phosphatide had no improving effect.

POMERANZ, Y., CARVAJAL, M. J. & HOSENEZ, R. C. **Jk 9**
1970
Wheat germ in breadmaking: I composition of germ lipids and germ protein fractions

Cereal Chem. **47** (4), 373–380.

Protein content was estimated in untreated and de-fatted granular wheat germ as also was the level of extraction by sodium chloride, calcium chloride and dilute acetic acid. Proteins in de-fatted germ and in a salt extract of germ were rich in most of the essential amino acids.

POMERANZ, Y., CARVAJAL, M. J. & SHOGREN, M. D. **Jk 10**
1970
Wheat germ in breadmaking: II improving breadmaking properties by physical and chemical methods
Cereal Chem., **47** (4), 429–437.

The author describes the effect on loaf volume of enriching white bread with raw germ, inactivated germ and germ extracts. The effect of adding sucrose monomyristate, lecithin and several phospholipids to bread enriched with germ or germ-protein is also discussed.

RAND, N. T. & COLLINS, V. K. **Jk 11**
Improving cereals with de-fatted wheat germ
Fd Technol. **12**, 585–588

The protein quality of defatted wheat germ was shown to compare favourably with high-quality fish meal. Mild heat treatment enhanced the protein quality. Supplementing cereals with 10 and 15% defatted wheat germ produced striking improvements in the nutritive value of wheat flour, rice, barley, oats and a mixture of these cereals.

RANHOTRA, G. S., HEPBURN, F. N. & BRADLEY, W. B. **Jk 12**
1971
Supplemental effect of wheat protein concentrate on the protein quality of white wheat flour
Cereal Chem. **48**

Increasing increments of wheat protein concentrate were added to white wheat flour and the effect on protein quality, dough properties, baking characteristics and resultant bread was studied. With increasing levels of addition, bread quality deteriorated, while protein quality improved as demonstrated by animal studies, which however also indicated destruction of essential amino acids during baking.

STERN, R. **Jk 13**
1944
Effects on flour doughs of extracts from unfermented and fermented wheat germ
Cereal Chem. **XXI** (2)

Wheat germ extracts contain soluble -SH groups and -SH groups attached to protein, the former having the injurious effect on dough. Fermented wheat germ contains less of both -SH groups. Soluble nitrogen actually decreases in doughs containing unfermented germ extract. Other findings are reported, and reasons are given for the assumption that the injurious effect of -SH groups is direct but of such a nature that the gluten can be restored to normal, i.e. to the condition obtaining in fermented loaves made from high grade flours.

VIDAL, F. D. **Jk 14**
1972
Baking additive
USA Patent No. 3 655 403

The addition of a partial hydrolysate of an edible protein such as soya protein or wheat gluten improves the volume and texture of baked products.

See also
B. 9: 19
C. 3
D. 12: 23
F. 10: 18: 39
Gb. 11: 14: 16: 20
Gc. 10
Ja. 14: 18–20: 28: 37: 43: 59
Jb. 2: 11: 26: 49: 54
Jj. 1
Jm. 14
Jn. 7

Milk

ANON **Jm 1**
1972
Yoghurt bread — bread of modern nutrition
Bull. Professionel Richemont, **28** (4), 67–68
(In French)

The use of yoghurt in the manufacture of wholemeal bread results in a product of higher nutritional value, better flavour and better keeping quality as compared with water-mixed wholemeal bread.

ANON **Jm 2**
1973
Whey in — for profit
Bakery Management, March 1973, pp 15–16.

The effects of using a proprietary whey powder in baked goods, confections, dry mixes and frozen foods are duscussed. Specific standards for the powder are given.

BECHTEL, W. G., HAMMER, G. E. & MAY, E. **Jm 3**
1956
Effect of calcium stearoyl-2-lactylate in bread made with non-fat milk solids of varying baking quality
Cereal Chem. **33**, 206–212

CROSSLEY, E. L. **Jm 4**
1969
The addition of dried skimmed milk to bread
Int. Dairy Fed. Bull. No. 3, p 30.

FORSUM, E., HAMBREAUS, L. & SIDDIQUI, I. H. **Jm 5**
1973
Fortification of wheat by whey protein concentrate, dried skim milk, fish protein concentrate and lysine monohydrochloride
Nutrition Reports International, **8** (1), 39–48.

Statistically evaluated results of chemical analyses and rat growth studies showed whey protein concentrate to possess high contents of essential amino acids, particularly lysine and threonine, and to be a more efficient protein supplement than fish protein concentrate or dried skim milk.

GLABAU, C. A.
1964 **Jm 6**
Re-evaluating the use of non-fat dry milk in bread production
Bakers Wkly **202** (10), 33–35

The behaviour and nutritive value of non-fat dried milk in baked products were studied. The protein and mineral contributions made in white bread by NFDM at levels of 3%–12% of flour weight are tabulated, and other qualities of the loaf are assessed. The use of dried milk gives a greater yield of dough and bread, which more or less offsets any higher cost incurred.

GUY, E. J., VETTEL, H. E. & PALLANSCH, M. J. Jm 7
1971
Effect of added cheese-whey concentrates on the rheological and sponge bread baking characteristics of doughs

Cereal Sci. Today **16** (9), (56th Ann. Meeting, American Ass. of Cereal Chemists.) Abstract only.

Nine isolates were tested, varying in protein content from 24 to 83%. Water absorption of doughs at constant levels of addition is a direct function of percentage whey-protein in the additives. The concentrate which gave the longest Farinograph stability produced good sponge doughs resulting in bread of excellent loaf volume and quality. (Shortened Abstract)

HANSEN, F. F. Jm 8
Method of making high-protein bread (milk protein added)

USA Patent No. 3,561,974

A method of making protein bread, high in all essential milk and cereal proteins, by using high-protein flour with soluble milk-protein concentrate, substantially fat-free and lactose-free. Bicarbonate of soda is used to raise the pH above 7 while producing a workable dough with less water, and sodium acid pyrophosphate restores the desirable normal acidity.

HENDERSON, J. O. & BUCHANAN, R. A. Jm 9
1969
Home-baked high protein milk biscuits

Aust. J. Dairy Technol. **24** (3), 116–118

Recipes based on the lactose-free milk-protein enriched milk biscuit, adapted for home baking.

HOFSTRAND, J. T., ZAEHRINGER, M. V. & HIBBS, R. A. Jm 10
1965
Functional properties of two compounds of cheddar cheese whey in bakery products. I cake doughnuts

Cereal Sci. Today **10** (5), 212

Lactose, whey protein and whole dried whey were added separately to a standard doughnut formula including buttermilk. Proteins and lactose had opposite effects; the protein gave a more elastic dough, smaller doughnuts and firmer crumb while the lactose gave less elastic dough, similar volume and softer crumb. The lactose doughnuts also tended to absorb more fat.

Jm 11
HORUBALOWA, A.
1972
Effect of dried skim milk on the quality of wheat bread

Przeglad Piekarski i Cukierniczy, **20** (8), 173–176
(In Polish)

Slower fermentation of bread dough resulted from additions of 1–10% dried skim milk, and the loaf volume was reduced by 1–15%. Sensory characteristics, crumb colour and crust colour were improved by additions of 1–3%. Additions of 6 and 10% enlarged the pores in the loaf and caused crust scorching.

Jm 12

HUBBARD, R.
1971
Breadmaking with milk powders
Fd Technol. N.Z. **6** (2), 22–23, 25.

The nutritional advantages of milk powder additions to bread are considered, and the improvements in crust colour, keeping quality, etc. are mentioned. The necessity of systematic bakery trials is discussed.

Jm 13

KAKOWSKA-LIPINSKA, I. & MUSZKATOWA, B.
1973
Enrichment of bread with dried skim milk and dried yeast.
I Organoleptic evaluation and composition and nutritional value of the enriched bread.
II Effect of baking process on contents of available lysine and biological and nutritional value of protein in the enriched bread Jm 13
Roczniki Panstwowego Zakladu Higieny, **24** (2), 195–213. (In Polish)

Mixed wheat/rye bread was enriched with 0–5% dried skim milk and dried yeast. Bread baked with the addition of 2% milk and 3% yeast contained 18% more protein and 53% more lysine, and this level of enrichment was judged best by sensory and nutritional tests.

Jm 14

KAUTZ, K.
1971
Process for manufacture and treatment of a ready-to-bake protein concentrate for baked products, and a protein concentrate produced by this method
West German Patent Application 2 025 023.
(In German)

The protein concentrate is made by dialysis of concentrated milk with blood to separate milk salts and sugar, admixture with wheat gluten, freeze drying and grinding. The concentrate can be combined with wheat or rye flour at a rate of 50%. The bread shows good keeping quality.

Jm 15

KINSELLA, J. E.
1971
The chemistry of dairy powders with reference to baking
Adv. Fd Res. **19**, 147–213

Review of the composition and chemistry of various components of dairy products in powder form, with particular reference to their effect on bread and baked goods.

Jm 16

KIRK, D.
1971
Milk and milk-based products for bakers
Bakers' Dig. **45** (5), 52–53, 70

Typical analyses and functional characteristics of 3 dairy-based blends and 3 cereal-based blends, all currently available commercially, are given in the form of tables. Components of these blends are whey, caseinate, buttermilk, corn and soya.

KRAFTCO CORPORATION
1973 Jm 17
Whey composition for making yeast-raised dough products
British Patent No. 1, 303, 265.

The process involves a whey product as a constituent of yeasted dough, containing whey solids, buffering and fortifying salts and minerals, maize flour and soya flour.

KREEN, M. I., LIBERT, T. L. & KASK, K. A. Jm 18
1969
Use of by-products of the dairy industry in breadmaking
Tallinna Polutehnitise Instituudi Toimetised, Seria A, 1969, No. 237, 49–57.
(In Russian)

Addition of 21% (by weight) of skim milk to wheat flour improved the sensory characteristics of bread but loaf volume was reduced. Addition of a further 8–12% of a skim milk preparation, or 4–4.5% of a food hydrolysate (preferably freeze-dried) obtained by cultivation of *Aspergillus oryzae* and lactic acid bacteria in skim milk, similarly improved taste and odour of the bread, accelerated fermentation and retarded staling.

MARSTON, P. E. Jm 19
1971
The use of dairy products in bread and other baked goods
Fd Technol. Aust. **23** (10), 506, 508, 509.

The author gives the history of milk bread in Australia and discusses developments in milk processing and milk bread production. He gives information on the milk powders suitable for bread and discusses the use of milk co-precipitate as an alternative to dried skim milk in bread etc.

MERTENS, M. H. & MYKLEBY, R. Jm 20
1967
Dairy products for bakery utilization
Bakers' Dig. **41** (5), 110–113.

A table is shown giving typical analyses of non-fat dry milk solids, dried whole milk, dried sweet buttermilk, sodium caseinate, cheddar cheese whey, dried cheddar cheese, dried sweet cream and whey-milk blend. Uses in the bakery for the various products are discussed.

MERTENS, M. H. Jm 21
1969
Functions of dairy ingredients in baking
Bakers' Dig. **43** (6), 57–60

The nutritional advantages of the use of dairy products in baking are discussed. Mention is made of the whey-based products currently popular in the USA and of other dairy products used in the bakery industry.

PATEL, R. B., MICKELSEN, R. & JOHNSON, J. A. **Jm 22**
1967
Use of hydrogen peroxide treated non-fat dry milk in the continuous dough mixing process
Cereal Sci. Today **12** (9), 377–378, 380–381.

In an attempt to overcome the adverse effects on dough mixing and loaf quality of the addition of 6% dry milk solids to the flour, the skim milk was treated with hydrogen peroxide at levels of 0.05, 0.10 and 0.20% for 10 minutes at 39° F before heating to 190° F for 30 minutes. Tables show the results of the treatment on bread quality and dough oxidant requirements. The treatment had the desired effect, but other conditions of processing must be optimal.

PEDRAJA, R. **Jm 23**
1965
Composition and nutritional value of dry milks with special reference to their supplementary value in cereal products
Cereal Sci. Today, **10** (4), (50th Ann. Meeting, American Ass. of Cereal Chemists). Abstract only.

The variations in composition of non-fat dried milk, whole-fat dried milk and dried buttermilk were studied, and the approximate mineral, vitamin and amino acid content of dried milks are presented. The nutritional significance of some of the components is cited, and the supplementary effect of the proteins of dried milks and those of cereals are discussed. (Shortened abstract.)

POTAVINA, V. C. & KASATKINA, G. D. **Jm 24**
1972
Use of milk whey in flour with low bread-baking properties
Khlebopek. kondit. Prom. No. 5, 12–14.
(In Russian)

Addition of whey and calcium peroxide to insect-infested flour partially compensated for its poor baking properties.

POTTER, G. L. & ZAEHRINGER, M. V. **Jm 25**
1965
Functional properties of two compounds of cheddar cheese whey in bakery products.
II Biscuits (Scones)
Cereal Sci. Today **10** (5), 215.

Tests were made using a standard scone formula containing dried milk, adding lactose, whey protein and whole dried whey separately to the mix. Lactose and whole whey gave softer and stickier dough and slightly larger scones. Whole whey gave darker crust, and lactose the whitest crumb. Whey protein gave stiffer dough and smaller, more compact scones. Protein and lactose additions gave results similar to the control. All had more flavour, the order of preference being lactose, whole whey, protein and lactose, protein.

SINGLETON, A. D., HANEY, H. N. & HABIGHURST, A. B. **Jm 26**
1965
Adapting dried whey products to present-day bakery operations
Cereal Sci. Today **10** (2), 53–55, 62.

Expanding use of edible whey solids, with saving in cost over the use of whole dried milk, has been partly due to the technological advances in spray drying of whey. Various types of whey product have been designed to be of specific benefit to the baker, and these advantages are illustrated by tables.

SWANSON, A. M. & SANDERSON, W. B. Jm 27
1967
Milk proteins responsible for deleterious effects in continuous mix bread
Cereal Sci. Today **12** (9), 363.

The effect of different types of milk products (non-fat dry milk solids, casein, whey) and of their major components was examined. The baking properties of the skim milk powder were improved by heating the skim milk at 185°F for 30 minutes at pH 8.7.

See also
B. 12
D. 2: 3: 7: 9: 23
E. 1: 3
F. 13: 15: 30: 33: 35: 37
Gb. 5: 18
Gg 1
Gj 3
Gk 4
Ja 1: 5–7: 9: 11: 17: 19: 28: 30: 32: 37: 38: 51: 52: 63

Fish protein concentrate, fish flour

Jn 1

HALLGREN, B.
1970
Effect of processing on the nutritional value of fish protein concentrate
Wenner-Gren Center Int. Symposium Series 14, pp 331–337.

A method is described for obtaining a protein concentrate from herring, with partial removal of the water-soluble protein. 1.75% and 4.5% of the FPC was added to a 50:50 mix of wheat and rye flours. At the lower rate the enrichment is due to the lysine in the concentrate and the same effect could be obtained by adding 4.5% soya protein or 0.15% lysine. At the higher rate of addition the enriching effect is due to the high content of essential amino acids other than lysine.

Jn 2

HALLIDAY, D. & DISNEY, J. G.
Fish protein concentrate: a review
Tropical Products Institute Report G58, 18pp

The review covers the history, potential output, production methods, acceptability, nutritive value, economics and usage of FPC, and includes a section on its suitability for the fortification of bread and pasta.

Jn 3

MOORJANI, M. N. & LAHIRY, N. H.
1970
The fish protein concentrate story. Efforts in India
Fd Technol. **24**, 56–59

Methods of preparation of fish protein concentrate are described, and the authors review the animal and child feeding trials reported by other workers. FPC prepared by extraction with ethanol (abs) was generally acceptable and could be incorporated at a level of 5–10% in wheat flour for chapatis, and at 2–5% in bread or biscuits. High levels of fortification could be used in highly flavoured foods.

Jn 4

MOORJANI, M. N.
1970
The fish protein concentrate story.
XII Processing of protein-enriched wafers
Fd Technol. **25** (12)

Fish protein was added to cassava flour, in various proportions, to make a nutritious wafer intended for consumption by persons subsisting on the cassava tuber.

Jn 5

MOORJANI, M. N.
1972
Fish protein concentrate in combating malnutrition
Indian Food Packer **26** (1), 47–49

The supplementation of diets with fish protein prepared from cheap or surplus fish is discussed. Trials demonstrated that a number of foods, such as bread, biscuits, chapatis and dhal can be fortified with fish protein concentrate, but there are problems associated with the consumer acceptance of such products.

SAMBUCETTI, M. E. & SANAHUJA, J. C. Jn 6
1970
El valor nutritivo de las harinas de pescado y su relación con el contenido en lisina y metionina disponibles

Arch. Lat. Nutr. (Venezuela), **20** (2), 119–133

SIDWELL, V. D., STILLINGS, B. R. & HAMMERLE, O. A. Jn 7
1967
Use of fish protein concentrate in foods: Effect on the physical, chemical and sensory evaluation of pasta made from WPC and semolina

Cereal Sci. Today **14** (3), (54th Ann. Meeting, American Ass. Cereal Chemists). Abstract only.

Pasta was prepared from WPC and semolina, incorporating 0, 3, 6, 9 and 12% FPC. The effect of the various increments of FPC on the rheology and stability of the doughs is described. FPC darkened the colour of the WPC dough (already brown) and greyed the yellow of the semolina dough, but the pastas lightened considerably on cooking. Protein losses and water absorption during cooking were similar for FPC pastas and control pastas; the FPC pasta tended to swell a little more than the control. (Shortened abstract).

SIDWELL, V. D. & HAMMERLE, O. A. Jn 8
1970
Changes in physical and sensory characteristics of doughs and of bread containing various amounts of fish protein concentrate and lysine

Cereal Chem. **47** (6), 739–745.

Doughs were prepared using up to 25% FPC or up to 1.0% lysine, and standard methods were employed to evaluate dough and bread. Fortification with lysine had little effect on characteristics of dough or bread, while FPC increased Farinograph development time and stability, and decreased extensibility and loaf volume. Bread containing over 10% FPC was less acceptable in flavour.

STILLINGS, B. R., SIDWELL, V. D. & HAMMERLE, O. A. Jn 9
1967
Nutritional quality of wheat flour supplemented with fish protein concentrate or lysine

Cereal Sci. Today **12** (3), (52nd Ann. Meeting, American Assn. of Cereal Chemists). Abstract only.

Wheat flour containing 5–25% FPC or 0.1–1.0% lysine was fed to weanling rats at a 10% protein intake level. Direct incorporation in the diet as flour gave better results than incorporation in the form of bread. Weight gain, PER, NPU, total protein and carcass fat all increased at levels of addition of up to 15% FPC. 0.2–0.4% lysine was comparable to 5% FPC. Higher lysine supplements had no further effect, whereas additional FPC improved protein quality up to the 15% level. Bread made from lysine fortified wheat reached maximum nutritional quality at 0.4% lysine, which was comparable to 10% FPC. (Shortened abstract).

See also
A. 19
B. 13: 37
C. 1
D. 15: 16
F. 18: 40
Gc. 15
Ja. 1: 2: 6: 9: 12: 17: 32: 37: 42: 51
Jm. 5

Amino acids

BLESSIN, C. W. *et al* Jo 1
1970
Lysine fortification of dent corn
Cereal Sci. Today **15**, 375–377, 394.

Infusion and coating procedures were investigated for obtaining elevated controlled levels of lysine in commercial dent corn. Average increase for whole kernels was from 0.24% to 1% after infusion with a 15% lysine solution at 160°F for 30 minutes. Of a number of materials evaluated for coating, zein and isolated soya protein were the most satisfactory, the amount of lysine added to the coating solution controlling the level of lysine in the product.

BRESSANI, R. *et al* Jo 2
1958
Supplementation of cereal proteins with amino acids. II Effect of amino acid supplementation of corn-masa at intermediate levels of protein intake on the nitrogen retention of young children
J. Nutr. **66**, 501–513

BRESSANI, R. *et al* Jo 3
1960
Supplementation of cereal proteins with amino acids. III Effect of amino acid supplementation of wheat flour as measured by nitrogen retention of young children
J. Nutr. **70**, 176–186.

BRESSANI, R. & MARENCO, E. Jo 4
1963
Corn flour supplementation. The enrichment of lime-treated corn flour with proteins, lysine and tryptophan, and vitamins
J. agric. Fd Chem. **11**, 517–522.

BRESSANI, R. Jo 5
1963
Supplementation of cereal proteins with amino acids. IV Lysine supplementation of wheat flour fed to young children at different levels of protein intake in the presence and absence of other amino acids
J. Nutr. **79**, 333–339.

BRESSANI, R. *et al* Jo 6
1963
Supplementation of cereal proteins with amino acids. V Effect of supplementing lime-treated corn with different levels of lysine, tryptophan and isoleucine on the nitrogen retention of young children
J. Nutr. **80**, 80–84.

BRESSANI, R. *et al* Jo 7
1963
Supplementation of cereal proteins with amino acids. VI Effect of amino acid supplementation of rolled oats as measured by nitrogen retention in young children

J. Nutr. **81**, 399–404

BRESSANI, R. Jo 8
1969
Considerations affecting cereal-based formulations

USDA Publication, ARS 72–71
(Proc. Conf. on Protein-rich Food Products from Oilseeds, New Orleans, May 1968*)*

The biological value of cereal protein is low owing to deficiency and poor overall balance of amino acids. Methods of correcting these disadvantages are described, such as the addition of protein concentrates or amino acids to various cereals.

BROWN, J. W. *et al* Jo 9
1959
The effect of lysine supplementation on the protein efficiency of high-protein breads

Cereal Chem. **36**, 545–553.

Rat-growth studies were made with diets in which white bread and three commercial protein breads were the sole protein source, with and without added lysine. Wheat protein made up 89–60%, milk and soya protein 11–40%. Protein quality (PER) was found to be a direct function of the lysine content of the mixed protein, whether a natural constituent or added as L-lysine monohydrochloride. For PER's in the range of 2 or over, at least 200 mg L-lysine/g N appears necessary.

CANTOR, S. M. & ROBERTS, H. J. Jo 10
1967
Improvements in protein quality in corn based foods

Cereal Sci. Today **12** (10), 443–445, 460–462.

Much of the concern over lysine tryptophan fortification of corn for humans has been eliminated by work at the Medical School in Cape Town, where improved nitrogen retention, as compared with unfortified corn, was observed in victims of kwashiorkor. A proposed method of estimating the relative merits of different types of protein enrichment is mentioned: a factor based on availability, acceptability and value would be used.

CARNOVALE, E. *et al* Jo 11
1969
Effect of manufacture on the amino acid composition of pasta made with added L-lysine, DL-methionine and L-threonine

Quaderni della nutrizione, Roma **29** (1/6), 53–62

4 samples of pasta were prepared from semolina fortified with (a) 0.3% lysine, (b) 0.3% methionine, (c) 0.1% threonine and (d) the same amounts of all three amino acids. 3 different sizes and shapes of product were manufactured and analysed for total protein and amino acids. Pasta size and shape had no effect on mean losses of the 3 amino acids, the losses being 26%, 5.2% and 5% respectively.

EHLE, S. R., HAUSE, N. L. & PAUL, D. E. **Jo 12**
1959
Taste and texture evaluation of lysine-supplemented baked products
Cereal Sci. Today **4** (3), 74–76.

No off-flavour resulted from the addition of nutritionally optimum amounts of L-lysine monohydrochloride to breads, cakes and doughnuts. Crust colour, which under standard baking conditions was darker for the lysine bread, could be adjusted by modifications in baking time and technique.

FERREL, R. E., SHEPHERD, A. D. & GUADAGNI, D. G. **Jo 13**
1970
Storage stability of lysine in lysine-fortified wheat
Cereal Chem. **47** (1), 33–37.

The stability of lysine added as lysine-HCl to wheat kernels by infusion was studied in storage conditions of 90° and 100°F at 9, 11, and 13% moisture. Chemical, organoleptic and biological tests showed that lysine stability remained relatively high throughout the storage period.

FERREL, R. E., FELLERS, D. A. & FINLEY, J. W. **Jo 14**
1972
Lysine-fortified bulgur
Cereal Sci. Today **17** (9), (57th Ann. Meeting, American Ass. Cereal Chemists). Abstract only.

Methods of lysine-fortification, and potential loss with the total-infusion technique, are described. Good penetration is necessary to minimize lysine loss in the pearling stage of bulgur production. Some studies on rates and pathways of lysine penetration are reported. PER data are supplied on the enhancement of bulgur with lysine. (Shortened abstract)

HOWE, E. E., JANSEN, G. R. & GILFILLAN, E. W. **Jo 15**
1965
Amino acid supplementation of cereal grains as related to the world food supply
Am. J. clin. Nutr. **16** (March), 315.

Evidence is advanced to the effect that where diet is totally lacking in animal protein, the protein consumed when calorific requirements are satisfied would be adequate if it were of a quality comparable to the animal proteins. Data show that supplementation with lysine, tryptophan and threonine increases the quality of cereal proteins to a level comparable to that of casein.

JANSEN, G. R., EHLE, S. R. & HAUSE, N. L. **Jo 16**
1964
Studies on the nutritive loss of supplemental lysine in baking: I Loss in a standard white bread containing four per cent non-fat dry milk
Fd Technol. **18** (3), 367–371.

Lysine monohydrochloride was added to standard white bread containing 4% NDM and the nutritional loss after baking was estimated by rat growth assay. Increased baking time greatly reduced the PER of both supplemented bread and control. Baking for 30 minutes at 450°F gave a 30% nutritional loss of lysine: HCl; baking for 20 minutes had no effect on rat growth but an 18% loss was indicated by chromatographic analysis.

JANSEN, G. R., EHLE, S. R. & HAUSE, N. L. **Jo 17**
1964
Studies on the nutritive loss of supplemental lysine in baking. II Loss in water bread and in bread supplemented with moderate amounts of non-fat dry milk

Fd Technol. **18** (3), 372–375.

From the results of their experiments the authors estimate that 15% of the lysine monohydrochloride added to bread is nutritionally lost during baking for 30 minutes at 450°F. Increased baking time gave higher loss. In standard 4% NDM white bread, further supplementation with NDM greatly increased the nutritive loss of lysine during baking, presumably because of its high content of D-lactose. Nutritive loss was estimated to be 36% in bread containing 6–14% NDM baked at 450°F for 20 minutes.

JANSEN, G. R. **Jo 18**
1970
Amino-acid supplementation and the world food problem

Wenner-Gren Center International Symposium series 14, 105–114.
(*Int. Symposium on Evaluation of Novel Protein Products, Stockholm,* 1968.)

Studies are reviewed which illustrate the feasibility of adding lysine and one other essential amino acid to wheat, corn, rice or millet to raise the protein value to that of casein. Lysine alone can raise the protein of teff, millet or sorghum to a similar extent. The advantages of using protein and amino acid supplements together, and the problems connected with amino acid supplementation, are discussed.

JENNESKENS, P. J. **Jo 19**
1969
Lysine enrichment of bulgur

Cereal Sci. Today **14** (5), 186–188.

The nutritional value of bulgur protein with and without additional lysine was assessed in chemical analyses and rat experiments. At an addition of 0.25% lysine HCl to bulgar the PER and NPU values were twice as high as those in the non-enriched bulgur. The effective lysine supplementation calculated by the chemical score method was at approximately the same level.

JENNESKENS, P. J. E. **Jo 20**
1971
Production of lysine-enriched bakery products

Netherlands Patent Application, 7004091.
(In Dutch)

Protein value and PER (weight gain in rats) improved when lysine or a lysine compounds was added to biscuits, chapatis and other non-leavened baked goods having a large surface:weight ratio.

MATTHEWS, R. H., RICHARDSON, G. & LICHTENSTEIN, H. **Jo 21**
1969
Effect of lysine fortification on quality of chapatis and yeast bread

Cereal Chem. **46** (1), 14–21

0.1–0.6% lysine was added to wheat flours (attas) used in leavened and un-leavened Indian bread and proved undetectable to a taste panel. Lysine reduced chapati volume and increased loaf volume. 4% loss of added lysine occurred in chapati baking, as compared with 25% in bread baking.

RICE, H. L., SHUMAN, A. C., MATTHIAS, R. H. & FLODIN, N. W. **Jo 22**
Nitrogen balance responses of young men to lysine supplementation of bread

J. Nutr. **100**, 847–854.

Male graduate students consumed diets in which 86–87% of total protein came from white flour and the remainder from non-fat dried milk, fruit and vegetables. After feeding bread diets without added lysine for 9 days, nitrogen balance responses were measured in the succeeding 12-day periods with experimental groups receiving diets containing L-lysine-HCl baked into the bread. Group responses to lysine were positive and significant.

ROSENBERG, H. R., ROHDENBURG, E. L. & ECKERT, R. E. **Jo 23**
1960
Supplementation of bread protein with lysine and threonine

J. Nutr. **72**, 423–428.

The authors describe the results of experiments on rats in supplementing a low protein bread diet with lysine and threonine. The optimal response was found to occur at a ratio of lysine to threonine of 1.67 to 1. The results confirmed that the next limiting amino acid in bread protein after lysine is threonine.

STAMICARBON, N. V. **Jo 24**
1971
Enriched cereal grains

British Patent No. 1 224 789.

The water content of cereal grains is increased by 10–45%, followed by cracking and treatment with an aqueous solution of amino acids.

TARA, K. *et al* **Jo 25**
1972
Effects of lysine on dough and protein quality of whole wheat meal chapatis and leavened bread

J. agric. Fd Chem. **20** (1), 116–118.

See also
F. 2
Gb. 10
Gc. 5: 6: 8: 15
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Gk. 4
Gm. 1
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Jb. 20: 36: 46
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Jd. 7
Jj. 1
Jk. 2: 12
Jm. 5: 13: 24
Jn. 1: 6: 8: 9

GARCHA, J. S., KAWATRA, B. L. & WAGLE, D. S. **Jp 1**
1971
Nutritional evaluation of leaf proteins and the effect of their supplementation to wheat flour by rat feeding
J. Fd Sci. Technol., Mysore, **8** (1), 23–25.

SATTERLEE, L. D., KENDRICK, J. G. & LISKA, K. J. **Jp 2**
1973
Hay! The future's high protein snack?
Snack Food **62** (4), 46–47.

Plant protein as fortification in snack foods is discussed, and the basic processes for production of leaf protein concentrate are noted. Low-cost high-protein flours from plants were selected by computer; the formulation consisted of 45.5% alfalfa, 10.6% soya bean, 26.6% potato and 17.2% glandless cotton seed. The high-protein flour was mixed with corn meal and water and extruded to give a puffed product.

TALWALKAR, R. T. & PATEL, S. M. **Jp 3**
1970
Biological evaluation (using rats) of proteins of ambadi *(Hibiscus cannabinus)* **and methi** *(Trigonella foenum-graecum)* **and their supplementary effect on jowar** *(Sorghum vulgare)*
Indian J. Nutr. Dietetics **7** (1), 13–16

See also
A. 19
B. 11: 13
D. 17
Gc. 10
Ja. 2

Single cell products

SCOTT, L. P., SANDERSON, M. & ASHTON, G. C. **Jq 1**
1972
A food vehicle for yeast protein
Can. Inst. Food Technol. J. **5** (2), 111–114.

Five yeasts were organoleptically evaluated in cereal wafers at various levels of incorporation. The maximum acceptable percentages of each yeast was determined by the average panel score. Brewer's yeast and Torula could be incorporated at 19%, representing 8% yeast protein in the wafers. The other yeasts were less acceptable.

YANEZ, E. *et al* **Jq 2**
1973
Nutritive value and baking properties of bread supplemented with *Candida utilis*
J. Sci. Fd Agric. **24** (5), 519–525.

The enrichment of bread with the yeast *Candida utilis* at 1, 2, 3, 6 and 10% levels was studied. The effect was adverse on physical dough characteristics, loaf volume (over 1% supplementation) and colour. The content of crude protein was increased from 14.4 to 21.3% in the 10% enriched bread.

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Ja. 2
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